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Hydrazine Blending and Storage Facility
Interim Response Action Implementation

Final Safety Plan
(Appendix C to Task Plan)

August 30, 1989
Contract Number DAAA15-88-D-0021
Task IRA H Phase I (Delivery Order 0003)

Rocky Mountain Arsenal
Information Center
Commerce City, Colorado

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PREPARED BY

Harding Lawson Associates
O.H. Materials Corporation

PREPARED FOR

OFFICE OF THE PROGRAM MANAGER FOR
ROCKY MOUNTAIN ARSENAL

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TABLE OF CONTENTS

	<u>Page</u>
LIST OF TABLES	iv
LIST OF FIGURES	v
1.0 INTRODUCTION	1
1.1 TASK SUMMARY	1
1.1.1 Task Order Scope of Work	2
1.1.2 Objectives	3
1.1.3 Health and Safety Responsibilities	3
2.0 SAFETY ORGANIZATION, ADMINISTRATION, AND RESPONSIBILITIES	5
2.1 RESPONSIBILITIES	5
3.0 SITE HISTORY AND OPERATION	7
4.0 TYPES OF WASTE	9
5.0 HAZARD AND RISK ANALYSIS	10
5.1 MECHANICAL	10
5.2 ELECTRICAL	10
5.3 ENVIRONMENTAL	12
5.3.1 Biohazards	12
5.3.2 Animals and Reptiles	13
5.3.3 Temperature	14
5.4 CHEMICAL	14
5.4.1 Ozone	15
5.4.2 Hydrogen Peroxide	15
5.5 ACOUSTICAL	16
5.6 UV LIGHT	16
5.7 FIRE AND EXPLOSION	17
5.8 SLIP/FALL	18
5.9 RISK ANALYSIS	18
6.0 SAFETY CONSIDERATIONS	19

TABLE OF CONTENTS
(Continued)

	<u>Page</u>
6.1 SAFETY TRAINING REQUIREMENTS	19
6.2 MEDICAL MONITORING	20
6.3 SAFETY PLAN IMPLEMENTATION AND MODIFICATION	21
6.4 STANDARD OPERATING PROCEDURES	21
6.5 SITE CONTROL AND ACCESS	22
6.5.1 Site Security	22
6.5.2 Site Access	22
6.5.3 Exclusion Zone	22
6.5.4 Contamination Reduction Zone	23
6.6 AIR MONITORING	23
6.7 CALIBRATION AND MAINTENANCE OF MONITORING EQUIPMENT ..	23
6.8 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION	23
6.9 FIRST AID MEASURES FOR OXIDANT EXPOSURE	24
6.10 SPILL CLEAN-UP PROCEDURES	25
7.0 SAFETY EQUIPMENT	26
8.0 SAFETY OPERATING PROCEDURES	28
8.1 GENERAL	28
8.2 SAFETY MEETINGS	28
9.0 ACCIDENT INVESTIGATION, REPORTING, AND AUDIT PROCEDURES	29
9.1 ACCIDENT INVESTIGATION AND REPORTING	29
9.2 COMPLIANCE AND AUDIT PROCEDURES	30
10.0 EMERGENCY PROCEDURES	32
10.1 LEAKS AND SPILLS	32
10.2 EXPLOSIONS	33
10.3 PERSONAL INJURIES AND MEDICAL EMERGENCIES	33
10.4 EMERGENCY COMMUNICATIONS	33

TABLE OF CONTENTS
(Continued)

	<u>Page</u>
11.0 SUBCONTRACTOR SAFETY EVALUATION	34
12.0 SHIPPING PROCEDURES	35
12.1 STEPS FOR COMPLYING WITH APPLICABLE DOT REGULATIONS	35
13.0 WASTE DISPOSAL PROCEDURES	39
13.1 GENERAL	39
13.2 INSPECTIONS	39
13.3 MARKINGS	39
13.4 HAZARDOUS WASTE CONTAINER LOG	39
13.5 CONTAMINATED WASTE DISPOSAL	40
13.6 DISPOSAL OF TREATED LIQUIDS BY CHEMICAL OXIDATION PROCESS	40
14.0 SAFETY PERMITS	41
15.0 SYSTEM SAFETY HAZARD ANALYSIS REPORT	42
15.1 PRELIMINARY HAZARD ANALYSIS	42
15.2 SYSTEM HAZARD ANALYSIS	42
16.0 AIR SAMPLING	44
16.1 N-NITROSODIMETHYLAMINE	44
16.2 HYDRAZINE FUELS	45
16.3 OZONE	45
17.0 LIST OF ACRONYMS AND ABBREVIATIONS	46
18.0 REFERENCES	48
APPENDICES	
A HAZARDOUS PROPERTY INFORMATION	
B MATERIAL SAFETY DATA SHEETS	
C RESPIRATORY PROTECTION PROGRAM	
D O.H. MATERIALS CORPORATION HEALTH AND SAFETY PLAN	
E RESPONSES TO COMMENTS SUBMITTED BY EPA AND SHELL OIL COMPANY	

LIST OF TABLES

<u>Table No.</u>		<u>Page</u>
4.1	Detected Contaminants and Concentrations	9A
5.1	Risk Analysis	18A

LIST OF FIGURES

<u>Figure No.</u>		<u>Page</u>
1.1	Location Map	1A
1.2	Location of Hydrazine Blending and Storage Facility	1B
3.1	Hydrazine Blending and Storage Facility Map	7A

1.0 INTRODUCTION

This Safety Plan has been prepared as Data Requirement A009, a requirement under Delivery Order 0003 (Task IRA H Phase I) of contract number DAAA15-88-D-0021 between Harding Lawson Associates (HLA) and its subcontractors and the U.S. Department of the Army (Army).

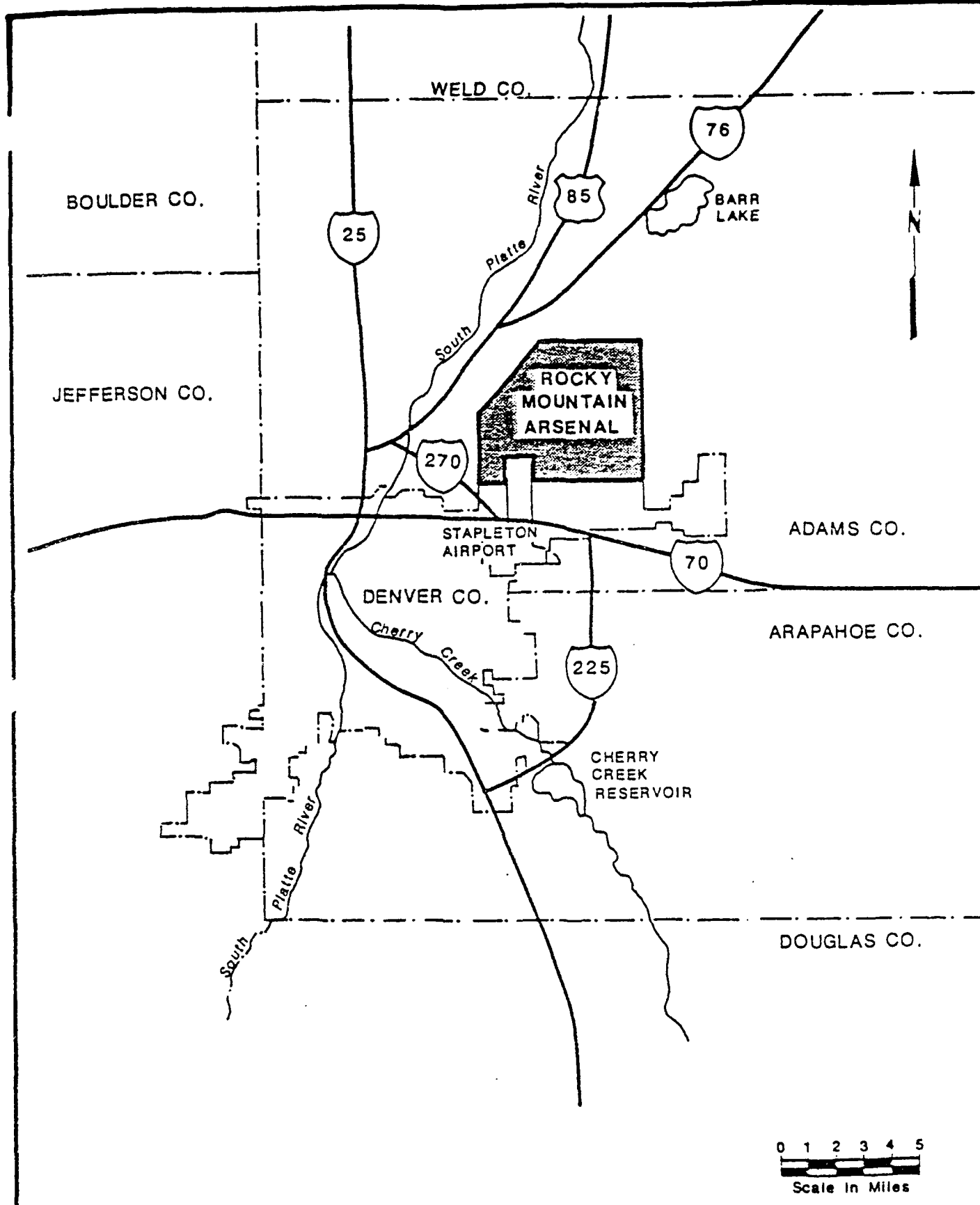
This document is submitted as an Appendix C to the Task Plan of the Hydrazine Blending and Storage Facility (HBSF) Interim Response Action (IRA). This plan details health and safety procedures to be followed during aspects of field activities to be conducted during construction, sampling, and operation of the hydrazine wastewater treatment system to be implemented at the HBSF at Rocky Mountain Arsenal (RMA).

1.1 TASK SUMMARY

The HBSF at RMA, near Denver, Colorado, (Figure 1.1) was constructed in 1959 and operated for 23 years from 1959 to 1982. The 10-acre site (Figure 1.2) consists of two distinct facilities, each completely surrounded by security fencing. The yards are connected by two overhead pipelines.

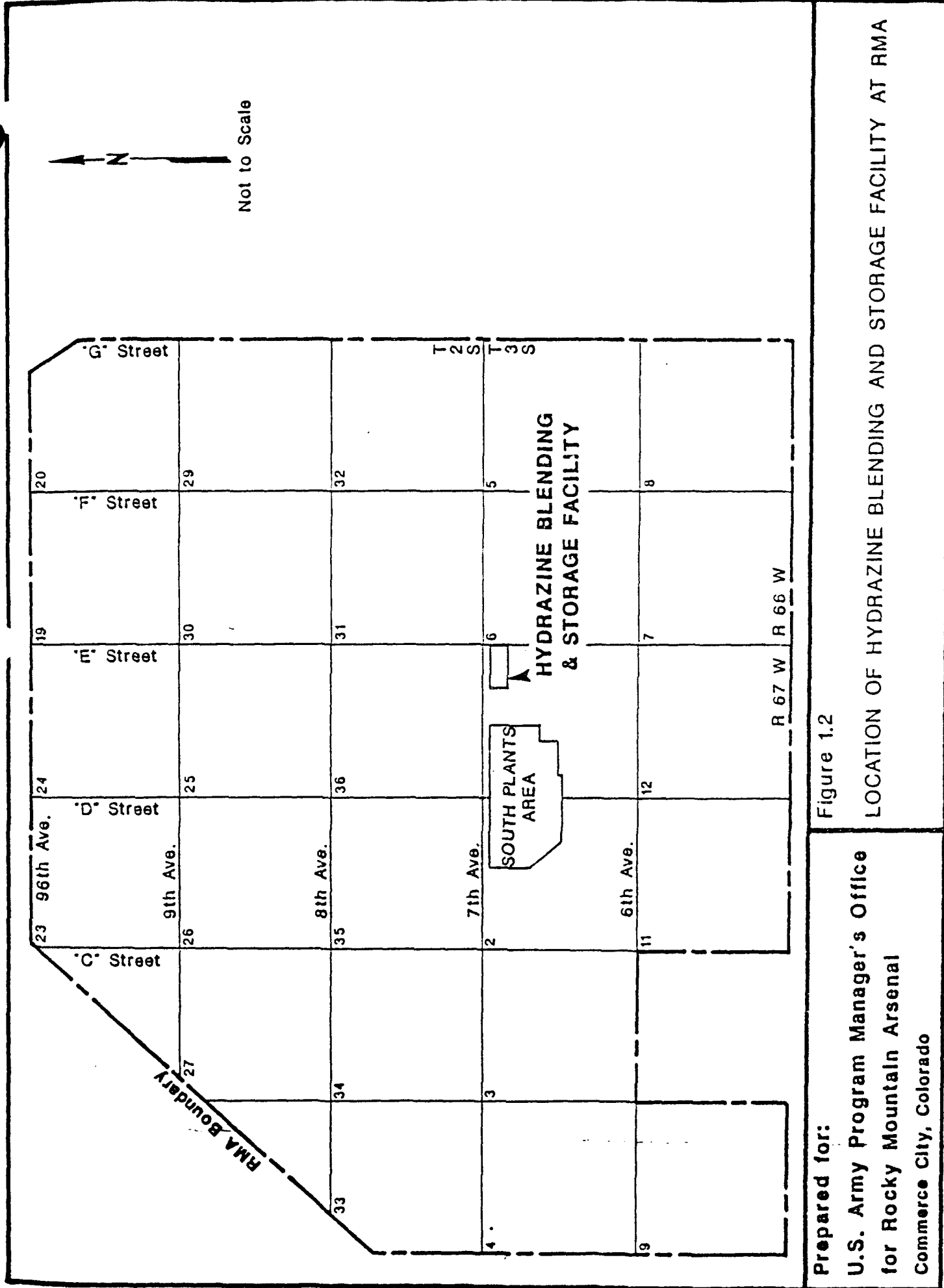
The HBSF was used as a depot to receive, blend, store, and distribute hydrazine fuels. The primary operation was blending of anhydrous hydrazine and unsymmetrical dimethylhydrazine (UDMH) to produce Aerozine 50. The materials were manufactured elsewhere and shipped to RMA for blending. Blending operations were not continuous and occurred in response to requests by the U.S. Air Force. Other operations at the HBSF included loading and unloading rail cars and tanker trucks, destruction of off-specification Aerozine 50, and storage of Aerozine 50, anhydrous hydrazine, monomethyl hydrazine (MMH), monopropellant hydrazine, hydrazine 70, UDMH, and hydrazine solutions.

Hydrazine and UDMH are unstable in the natural environment and rapidly decompose when exposed to the atmosphere. One of the decomposition products of UDMH is n-nitrosodimethylamine (NDMA), a suspected human carcinogen. From January through March 1982, the U.S.



Prepared for:
U.S. Army Program Manager's Office
for Rocky Mountain Arsenal
Commerce City, Colorado

Figure 1.1
LOCATION MAP



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Commerce City, Colorado

Figure 1.2

LOCATION OF HYDRAZINE BLENDING AND STORAGE FACILITY AT RMA

U.S. Occupational Safety and Health Administration (OSHA) surveyed the HBSF and detected the presence of airborne NDMA within the HBSF. In May 1982, RMA ceased operations and closed the HBSF to all but safety-essential or emergency-response entries.

On February 1, 1988, a proposed Consent Decree was filed in the case of *U.S. v. Shell Oil Company* with the U.S. District Court in Denver, Colorado. A modified version of the Consent Decree was filed on June 7, 1988. On February 17, 1989, a Federal Facility Agreement (FFA) that incorporates the provisions of the modified Consent Decree was executed by the U.S. Army, Shell Oil Company, the U.S. Environmental Protection Agency (EPA), the U.S. Department of the Interior (DOI), the U.S. Department of Justice (DOJ), and the U.S. Department of Health and Human Services (DHHS). The FFA specifies a number of Interim Response Actions (IRAs) to alleviate certain concerns prior to the final remedial action. IRA H, closure of the HBSF, is to be implemented at the HBSF. The IRA process described in the FFA requires preparation of an Assessment Document, a Decision Document to include Applicable or Relevant and Appropriate Requirements (ARARs), and a Draft Implementation Document prior to implementation of the response action. At this time, the Assessment Document and Decision Document have been completed. HLA will develop the Draft Implementation Document. This section presents a summary of the scope of work for the task.

1.1.1 Task Order Scope of Work

The HBSF IRA H Task has been separated into two phases, which comprise the decommissioning of the HBSF at RMA. Phase I includes planning, wastewater treatment system selection and modification (including bench/pilot-scale testing), full-scale system installation, analytical method development and laboratory method certification, treatment system start-up testing, and development of a Draft Implementation Document for facility decommissioning. Phase II will involve planning, installation of a second wastewater treatment system, operational treatment of hydrazine wastewater, reduction and elimination of the facility hazards, dismantling of all above-ground structures and equipment, disposal of generated solid and liquid waste

streams, and preparation of a Technical Report to document facility decommissioning. The present Task Order addresses only Phase I of IRA H.

1.1.2 Objectives

The principal Phase I objectives are to:

- Conduct a bench/pilot-scale testing program to select an appropriate chemical oxidation/ultraviolet (UV) irradiation treatment system for treatment of hydrazine wastewater stored at the HBSF
- Determine necessary treatment system modifications to achieve the desired discharge concentrations for the chemicals of concern in the wastewater
- Develop and certify an analytical method for analysis of NDMA in treated wastewater to attain the lowest technologically achievable Certified Reporting Limit (CRL)
- Conduct start-up testing of the selected full-scale treatment system at the HBSF
- Gather sufficient process information from the start-up testing to more specifically define operational treatment requirements
- Prepare a Draft Implementation Document defining step-by-step procedures for decommissioning above-ground equipment and treatment of remaining hydrazine wastewater at the HBSF

1.1.3 Health and Safety Responsibilities

Health and safety responsibilities for the HBSF IRA H Phase I work are split between HLA and the O.H. Materials Corporation (OHM) depending on the current task activity. Task activities addressed by this Health and Safety Plan (HSP) comprise primarily onsite work. The task activities and primary responsibilities are summarized as follows:

<u>Task Activity</u>	<u>Primary Responsibility</u>
Bench/Pilot-Scale Test Wastewater Collection	HLA
Site Facilities Inspections for Design	HLA
Site Improvements/Construction	OHM
Treatment Plant Installation	OHM
Initial Start-up of Full-Scale System	OHM
Long Term Start-up	HLA
Treatment Plant Modifications	OHM

Wastewater Sampling

HLA

Facility Investigation for Implementation
Document Preparation

OHM

Primary responsibility means the company so indicated will provide the site safety officer, and all work performed by both HLA and OHM on the respective task activity will be conducted under the safety direction of that officer.

This HSP essentially incorporates two plans, one prepared by HLA and the second prepared by OHM. The OHM plan is included as Appendix D to the HLA HSP and is designed to be a stand-alone document. As such, the OHM plan incorporates some identical material contained in the HLA plan. This approach to the plan was taken to provide OHM site personnel with a plan to use specifically for their activities. Because OHM is subcontractor to HLA on the task and HLA is ultimately responsible for all task work, including safety of task performance, the OHM HSP is included as part of the HLA HSP.

2.0 SAFETY ORGANIZATION, ADMINISTRATION, AND RESPONSIBILITIES

Health and safety within HLA is managed through the corporate Industrial Hygiene and Safety Division in Novato, California, which is responsible for coordinating all health and safety activities within the company and serves as *project consultant on health and safety issues relating to this project.*

Each branch office has a designated Health and Safety Officer (DHSO). Each DHSO is responsible for implementing corporate directives and policies within each office, ensuring compliance with federal and state regulations, and coordinating area office health and safety activities. In the Denver office, the DHSO reports directly to the Office Manager on all local health and safety issues.

The Task Manager for this project is responsible for all aspects of this task, including health and safety. The Denver DHSO has been designated as Health and Safety Manager (HSM) for this task. The HSM will be responsible for preparing, implementing, and monitoring the effectiveness of health and safety procedures and equipment.

An Onsite Health and Safety Officer (HSO) will be responsible for daily activities at the treatment plant and the safety of all other personnel working in the plant. The latter personnel will be responsible for daily plant operation and maintenance (O&M).

2.1 RESPONSIBILITIES

A minimum of two people will be present during operation of the pilot plant. The following health and safety job descriptions will apply at the site.

Site Supervisor

The Site Supervisor will report to the Task Manager and will have total control over facility activities. Specific responsibilities will include:

- Coordinate activities with appropriate officials
- Brief individuals on their specific assignments
- Ensure that safety and health requirements are met

- Prepare reports and maintain files related to facility operation
- Oversee the entire operation and monitor effectiveness of contaminant destruction

Onsite Health and Safety Officer

The onsite HSO will advise all personnel on health and safety issues at the facility. The HSO will recommend stopping work if any operation threatens worker or public health or safety. Specific responsibilities will include:

- Select protective clothing and equipment
- Periodically inspect protective clothing and equipment
- Ensure that protective clothing and equipment are properly stored and maintained
- Control entry and exit at the Access Control Points
- Confirm each worker's suitability for work based on a physician's recommendation
- Monitor the work parties for signs of stress, such as cold exposure, heat stress, and fatigue
- Monitor onsite hazards and conditions
- Conduct periodic inspections to determine if the HSP is being followed
- Enforce the "buddy" system
- Know emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department
- Notify, when necessary, local public emergency officials
- Coordinate emergency medical care

3.0 SITE HISTORY AND OPERATION

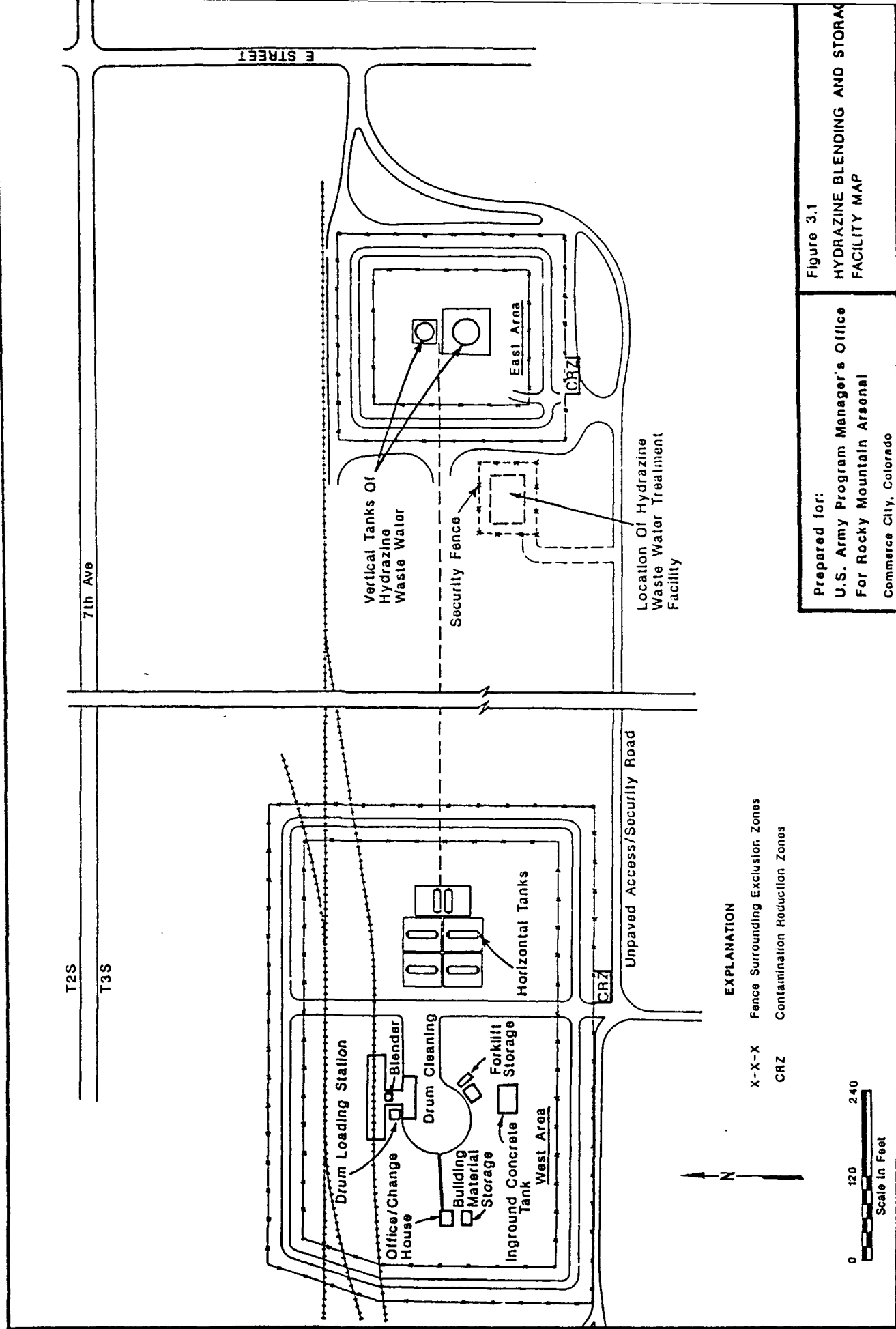
The HBSF was owned by the U.S. Air Force and was operated by the U.S. Army from 1959 to 1982 (EBASCO and others, 1988). The HBSF is located in the northeast corner of Section 1 on RMA, to the east of the South Plants area. The site consists of two yards, each surrounded by a double security fence. The yards are connected by overhead pipelines (Figure 3.1).

The western portion of the HBSF was constructed in 1961. This area was used to load and unload rail cars and tank trucks. An office, blending equipment, and storage are also located in this area. Storage facilities include a 44,000-gallon in-ground concrete wastewater tank, drum storage pad with drum filling equipment, and equipment sheds. The eastern area was built in 1976 to provide additional storage and includes a 50,000-gallon tank and a 200,000-gallon tank.

In addition to storage, the HBSF has been utilized to receive, blend, and distribute hydrazine fuels. Fuel materials were imported to RMA from other sources for blending on an as-needed basis dictated by the Air Force. The most common operation was production of Aerozine 50, a blend of UDMH and hydrazine. Aerozine 50, UDMH, hydrazine, anhydrous hydrazine, MMH, monopropellant hydrazine, and hydrazine 70 were stored at the site. Destruction of off-specification Aerozine 50 also occurred at this site.

The maximum volume of hydrazine wastewater currently stored onsite is estimated to be 300,000 gallons. This wastewater is stored in two vertical steel tanks and one in-ground concrete tank. Residues from drum filling and washing operations also have been collected and stored in the in-ground concrete tank. A batch treatment with solid calcium hypochlorite was used to oxidize hydrazine into ammonia, nitrogen, and water. Sludge from this process was disposed in pits located in Sections 30 and 36 on RMA from 1975 through 1978. Treated wastewater was pumped through an industrial sewer to Basin F until 1982. Thereafter, neutralized wastewater was stored onsite, except for approximately 10,000 gallons shipped to Lowry Air Force Base.

Records of only two large spills are noted for this facility. In 1975, the fire protection system malfunctioned and filled the pit around the largest UDMH storage tank with several



hundred thousand gallons of water. No fuels or wastewaters were spilled. The water in the filling pit from the fire protection system was pumped into adjacent fields. In 1976, the same tank leaked UDMH to a depth of approximately 4 inches into the surrounding pit. The UDMH was pumped into storage, neutralized and disposed in Basin F.

Prior to shutdown of operations at the facility in May 1982, OSHA detected airborne NDMA onsite. In December 1982, the U.S. Army Environmental Hygiene Agency conducted a sampling program at the HBSF. Results from this sampling indicated that ambient air did not contain detectable concentrations of UMDH or hydrazine, and wipe samples from connectors and nozzles indicated low concentrations of UDMH and hydrazine. (Wipe samples were used only to determine contaminant locations, not to assess the level of contamination.) All work areas showed some detectable NDMA air contamination, at concentrations ranging from no detection to $20.0 \mu\text{g}/\text{m}^3$.

An additional air monitoring program was conducted by Dames & Moore in 1987 to determine the level of personal protection needed for safe entry into the HBSF and to determine whether additional clean-up was required at the facility. Results of this sampling indicated that the air within the tanks used to blend, formulate, and store hydrazine is contaminated by NDMA in concentrations ranging from $0.20 \mu\text{g}/\text{m}^3$ to $28 \mu\text{g}/\text{m}^3$. Ambient air monitoring within the facility did not indicate airborne NDMA at a detection limit of $0.05 \mu\text{g}/\text{m}^3$.

4.0 TYPES OF WASTE

Several contaminants in wastewater at the HBSF have been identified. Table 4.1 lists these contaminants and their concentration range or maximum detected value. Hazardous property information on the contaminants is provided in Appendix A (Table 1). Appendix A also lists hazard properties for hydrogen peroxide, ozone, and other chemicals that will be used in the treatment process. It should be noted that hydrazine, MMH, UDMH, and NDMA were the only compounds detected at significant concentrations at the site. Material Safety Data Sheets (MSDSs) for these four compounds are provided in Appendix B. The remaining chemicals listed in Table 4.1 were detected at concentrations less than Resource Conservation and Recovery Act limits and are not included with the MSDS compilation in Appendix B.

Table 4.1: Analytical Results - Wastewater from the
HBSF Facility, RMA, Colorado

<u>Parameter</u>	<u>Unit</u>	<u>Concentration*</u>
Arsenic	mg/l	0.0070
Cadmium	mg/l	0.0022
Chromium	mg/l	0.0010
Lead	mg/l	0.0010
Mercury	mg/l	0.0050
Selenium	mg/l	0.0004
Silver	mg/l	0.0020
Sodium hypochlorite	mg/l	0.0250
Chlorine residuals	%	0.1400
Hydrazine	mg/l	<5.0 - 1500.0
Monomethyl hydrazine (MMH)	mg/l	<5.0 - 104.00
Unsymmetrical dimethyl hydrazine (UDMH)	mg/l	<5.0 - 1600.0
N-nitrosodimethylamine (NDMA)	µg/l	2.9 - 360
Methylene chloride	mg/l	0.06 - 33.0
Chloroform	mg/l	<0.0005 - 15.0
1,1-Dichloroethane	µg/l	<1.7 - 1.98
1,1-Dichloroethylene	µg/l	<0.73 - 5.0
Tetrachloroethane	µg/l	<20.0
Dimethylcyanamide	µg/l	<20.0
N-N-dimethylformamide	µg/l	<20.0
1-ethyl 1H 1,2,4-Triazole	µg/l	<20.0
Endrin	µg/l	0.0100
Lindane	µg/l	0.0100
Methoxychlor	µg/l	0.2000
Toxaphene	µg/l	0.0100
2,4,5-TP (Silvex)	µg/l	0.1000

* Typical concentration ranges; actual concentration may vary

Reference: Ebasco and others, 1988

5.0 HAZARD AND RISK ANALYSIS

Many potential physical hazards exist or will exist at the HBSF and the treatment plant.

This section discusses those hazards and evaluates the potential and probability that the hazards will occur, the consequences of the hazards, and safety precautions to mitigate these hazards. The potential hazards identified for this site are:

- Mechanical
- Electrical
- Environmental
- Chemical
- Acoustical
- UV light
- Fire and explosion
- Slip/fall

5.1 MECHANICAL

The following precautions should be taken when working around mechanical equipment:

- Stand clear of mechanical equipment, and tag and lock out electrical equipment before performing maintenance. Some equipment can start or stop without warning.
- If moving part covers are to be removed for maintenance, the equipment must be stopped before removal. Start-up should not occur before the cover is replaced.
- Avoid wearing loose clothing. Tie back long hair.
- Avoid contact with motors, as they may be extremely hot.
- Operation devices should be protected from unintended operation.

5.2 ELECTRICAL

The most important safety practice to remember is to tag and lock out the power supply to equipment when maintenance or repair is conducted. First, the main circuit breaker should be shut off; then each person should place his/her own keyed lock on the breaker and attach a tag at

all points where such equipment or circuits can be energized. This will prevent possible electrocution should an employee turn on the electricity while another is still working on the equipment.

The following are general guidelines to be followed while working with electrical equipment:

- Inspect and test equipment prior to use.
- Be familiar with the 1988 Edition of National Electric Code.
- CPR training is suggested.
- Always work with a "buddy."
- Repair frayed or exposed wiring prior to use.
- Do not use metal ladders.
- Portable electrical equipment should be doubly insulated or grounded.
- Extension cords should be three-wire grounded.
- No 3- to 2-prong adapters will be used.
- Only authorized personnel are permitted to work on high-voltage equipment.
- Do not work on electrical equipment if water or liquids are on the floor near the work area.

Use of extension cords should be avoided. If there is no other option, the guidelines below should be followed:

- Extension cords are to be used only in an emergency and are only for temporary use.
- All extension cords must be heavy-duty service type.
- Do not run extension cords through any openings.
- Do not staple or nail extension cords in place.

The power-control box for the treatment equipment will have a fused safety disconnect power switch to protect O&M personnel required to work inside this enclosure. If this safety switch is circumvented for any reason, exposed high-voltage contacts within the power-control box must be avoided while servicing or testing the power-control circuitry.

Likewise, the electrical power to the ozone generator control cabinet also utilizes a safety disconnect switch to protect personnel from high operating voltages in the generator. If this safety switch is circumvented for any reason, extremely dangerous high potentials must be avoided while servicing or testing the internal circuitry of the ozone generator.

The electrical power input to the UV lamp ballast has an electrical interlock switch to remove the power from the input to the lamp ballast enclosure whenever the enclosure doors are opened. If it is necessary to circumvent this safety interlock, service personnel must take care to avoid both the input power to and the output power from the UV lamp ballasts.

The upper contacts of the UV lamps are housed under a light shield cover. Extreme caution must be exercised while servicing or testing this UV lamp circuitry when the lamp power is on.

The input power to the ozone decomposer heater is switched and distributed from the reactor power-control box. These input power contacts for the high-voltage heater(s) are covered and protected by an electrical enclosure. If it becomes necessary to remove the heater cover(s) for either servicing or testing of the ozone decomposer heater when under power, extreme caution must be exercised by O&M personnel.

An additional consideration for operating and maintaining the ozone decomposer assembly is the operating temperature. The ozone decomposer assembly on the UV/oxidation reactor utilizes an electric heater to remove condensation from the catalyst bed of the decomposer. Do not touch either the ozone decomposer catalyst chamber housing or piping or the electric heater housing while the system is in operation. Surface temperatures on these housings can exceed 200°F.

5.3 ENVIRONMENTAL

5.3.1 Biohazards

During any work activity, cuts and abrasions may lead to infections. The following suggestions should minimize infections from cuts and abrasions:

- Wear surgical gloves when in contact with chemicals or potentially contaminated materials.
- Wash hands when possible, and shower and change clothes before leaving the plant.

- Do not put fingers in eyes, nose, or mouth while working.
- Immediately clean all cuts and scratches with antiseptic. See a doctor if swelling or infection occurs.
- Complete a first aid class.
- Ensure that tetanus immunization is up to date.

5.3.2 Animals and Reptiles

It was recently disclosed that sylvatic plague had spread from isolated prairie dog colonies to encompass a large portion of the prairie dog population at RMA. Transmission of the plague is usually through the fleas or handling of infected animals. All personnel should avoid contact of any kind with the prairie dogs. Without close contact, it is improbable that transmission of the plague will occur. However, if personnel exhibit flu symptoms, they should see a doctor and inform the doctor that plague exposure is a possibility.

Rattlesnakes continue to be sighted at RMA. Care should be taken when walking around the site. Wearing high-top work boots will provide some measure of protection. In the unlikely event of a snakebite, the following procedures should be followed:

- Call an emergency medical service or get the victim to a medical facility as soon as possible.
- Keep victim calm and still. Snakebite reactions are aggravated by anxiety and fear.
- Keep bitten area below level of heart, if possible, and keep it immobile.
- Treat for shock, if necessary.
- Give mouth-to-mouth resuscitation if breathing stops.
- Begin CPR if breathing and heartbeat stop.
- Do not give victim aspirin.
- Do not use ice on the bite.

Mortality rates for rattlesnake bite victims are low, but crippling injuries can result. Medical care should be sought even if the victim shows no adverse reactions.

5.3.3 Temperature

Heat stress is a potential hazard, particularly while personnel are working in Level B (see Section 6.8). To avoid heat stress or heat stroke, personnel should follow these precautions when the temperature exceeds 75°F:

- Take a 10- to 15-minute break every two hours (if necessary) in a shaded area.
- Unzip or remove coveralls during breaks.
- Frequently drink small amounts of cool water or electrolyte replenishment solution.
- If pulse exceeds 110 beats per minute at the beginning of the rest period, shorten work cycle by one-third.

Personnel will monitor each other for heat stress while working, as a victim may be unaware that he/she has been affected. Heat stress may be indicated by cool, moist skin, dilated pupils, headache, dizziness, muscular pains, and cramps.

5.4 CHEMICAL

Hydrogen peroxide and/or ozone may be used as oxidants with the UV/chemical oxidation treatment system. Care will always be exercised when working in and around the treatment plant. Constant air monitoring will be conducted, and personal protective equipment (PPE) will be donned, depending on ambient air readings. PPE will also be used when handling chemical compounds or wastewater. The following precautions will be taken:

- Be familiar with the hazard property information available in Appendices A and B of this document
- Wear appropriate PPE when necessary
- All leaks and spills are to be reported and cleaned up immediately upon discovery
- Large spills that cannot be cleaned up immediately should be reported to the HSM
- Be familiar with locations and operation of first aid and emergency equipment

5.4.1 Ozone

High concentrations of ozone (O_3) (0.100 ppm or greater) may be very irritating or toxic, depending on exposure. Personnel should avoid any direct or extended contact with ozone. All piping, valves, meters, fittings, and seals used to distribute ozone from the ozone generator through the reactor system and into the ozone decomposer assembly should be secured and tested for ozone leaks. If it becomes necessary to open up or disconnect any of the ozone distribution system for servicing or testing, make certain that any ozone output from the system is not discharged into areas where humans or objects/materials sensitive to ozone are present.

The MSDS for ozone is included in Appendix B.

5.4.2 Hydrogen Peroxide

Contaminated hydrogen peroxide (H_2O_2) decomposes to release oxygen and heat. In dilute solutions, the heat produced is usually absorbed by the water present; in more concentrated solutions, the heat raises the temperature of the solution and accelerates the decomposition rate. Therefore, all handling procedures must ensure product integrity by preventing contamination.

Hydrogen peroxide will be stored only in original containers or containers of compatible materials that have been properly designed and thoroughly passivated. Hydrogen peroxide removed from its original container will never be returned to it. All containers must be properly vented and stored away from sources of direct heat and combustible materials. Adequate ventilation and an ample water supply for diluting and washing away accidental spills will be provided.

Fires caused by hydrogen peroxide are best controlled by using large quantities of water. The chemical itself does not burn, but its decomposition liberates oxygen, which supports combustion.

Hydrogen peroxide is not considered to be an explosive. However, when it is mixed with organic substances, hazardous impact-sensitive compounds may result. Even small amounts of materials containing catalysts such as silver, lead, copper, chromium, mercury, and iron oxide can

cause immediate decomposition and explosive rupture of the containing vessels, even if the vessel is properly vented.

Rubber gloves and suitable protective clothing will be worn when handling hydrogen peroxide. Concentrated solutions have a corrosive effect on the skin, mucous membranes, and eyes and will be washed off immediately with generous quantities of water.

Safety goggles will always be worn when handling hydrogen peroxide. If the chemical should come in contact with the eyes, thoroughly flush the eyes with water for 15 minutes and promptly consult a physician.

Although 3 percent hydrogen peroxide solutions are often used as a gargle or a mouthwash, more concentrated solutions should never be allowed to come in contact with the mouth. If hydrogen peroxide is swallowed, give the victim lukewarm water and call a physician.

Hydrogen peroxide and its decomposition products, oxygen and water, are not systemic poisons. However, hydrogen peroxide vapor can cause irritation and inflammation of the respiratory tract. If inhalation has been prolonged, fresh air will be sought at once and a physician will be consulted immediately.

Clothes must be washed thoroughly with water if they come in contact with hydrogen peroxide; if allowed to dry on the fabric, H_2O_2 may cause fire, particularly if the clothing is soiled.

The MSDS for hydrogen peroxide is included in Appendix B.

5.5 ACOUSTICAL

Ear protection (foam plugs or ear muffs) will be worn at any time a normal conversation cannot be conducted at a distance of 3 feet.

5.6 UV LIGHT

There is a potential for nonionizing radiation exposure from the UV lights used in the treatment plant. Following installation of the selected treatment process and prior to start-up, the

vendor will be required to monitor for harmful UV dosages. If necessary, an effective barrier, such as window glass, will be installed.

5.7 FIRE AND EXPLOSION

In pure form, the hydrazine compounds found in the wastewater present a high risk of explosion and fire. The dilute concentrations of hydrazines found in the wastewater at the HSBF, however, are not expected to pose a hazard. The chemicals used during the treatment process (hydrogen peroxide and ozone) will be in less dilute forms and will be of much greater risk.

The following guidelines are to be followed to minimize the risk of fire and/or explosion:

- Ventilation should be maintained on a 24-hour basis to prevent buildup of explosive gases.
- Personnel should be familiar with locations and operation of portable fire extinguishers. All extinguisher locations will be clearly marked, and access to these locations will not be blocked in any manner. Extinguishers will be checked for charge on a weekly basis. Fire extinguishers will be of the appropriate type for the fire hazards existing at the site.
- No smoking will be permitted on the treatment plant premises or inside the storage tank area. Smoking will be permitted only at the contractor's support office.
- Do not allow rubbish and trash to accumulate.
- Minimize dust accumulation.
- Oily rags should be placed in airtight containers and/or submerged in a container of water.

Flammable liquids have a low flash point and are a primary source of fire and/or explosive risk. These liquids should be treated with particular care. The following are guidelines for proper handling of flammable liquids:

- Be aware of the hazard properties of these liquids. Adhere to manufacturers' guidelines for storage and handling.
- Keep flammable liquids in labeled, appropriate containers only.
- Provide adequate ventilation at all times.
- Do not mix flammable liquids.
- Keep liquids away from potential sources of ignition. No smoking will be permitted inside the plant or in the storage tank area.

- When transferring flammable liquids from one container to another, attach ground wire to the containers.
- Allow for expansion when filling containers.
- Storage containers will be properly grounded and bonded.
- Chemical storage rooms should meet required fire resistance ratings.

5.8 SLIP/FALL

When floors are wet, care should be taken to avoid slipping or falling. Spills should be cleaned up immediately to minimize the slip/fall hazard. Rubber soled boots should be worn during this activity. While moving around the plant area, care should also be taken to avoid tripping and resultant possible injury.

5.9 RISK ANALYSIS

Table 5.1 presents the risk analysis for this particular task. All the hazards discussed in Sections 5.1 through 5.7 are listed as well as the potential for exposure, probability that the exposure will occur, and the consequence of that exposure.

Table 5.1: Risk Analysis

<u>Hazard</u>	<u>Exposure</u> ¹	<u>Probability</u> ²	<u>Consequence</u> ³
Mechanical	CONT	LIKE	MIN-FATAL
Electrical	CONT	LIKE	MOD-FATAL
Environmental	CONT	UNU	MIN-FATAL
Chemical	FREQ	UNU	CHRON-FATAL
Acoustical	CONT	UNU	CHRON
UV Light	OCC	IMP	MOD-SER
Fire and Explosion	OCC	LIKE	MIN-FATAL
Slip/Fall	CONT	UNU	MIN-SER

¹Exposure: The frequency of exposure to the hazard event

- a. CONT Continuously - many times daily
- b. FREQ Frequently - once/day or twice/day
- c. OCC Occasionally - once/week to once/month
- d. SELD Seldom - once/month to once/year

²Probability: The likelihood that an injury will occur upon exposure to the hazard event

- a. CERT Certain or almost certain
- b. LIKE Likely, not unusual, 50/50 chance of occurring
- c. UNU Unusual, would happen less often than not
- d. IMP Improbable, not likely to happen

³Consequence: The degree of injury resulting from exposure to the hazard event if an injury occurs

- a. FATAL Fatality
- b. SER Serious injury, including chemical exposure requiring hospitalization
- c. MOD Moderate injury, including chemical exposure requiring outpatient medical treatment
- d. MIN Minor injury, including chemical exposure requiring onsite first aid
- e. CHRON Chemical, acoustical, or other exposure above TLV or other recommended standard that may not produce immediate acute effects (especially for chronic toxicants)

6.0 SAFETY CONSIDERATIONS

A safe working environment is promoted by exercising care and good judgment. HLA is responsible for creating a safe workplace, but plant personnel are responsible for maintaining safe working conditions. Accidents can be prevented by using common sense and by becoming familiar with the hazards associated with operation of the treatment plant. When a particular hazard is noted, immediate corrective action should be taken to eliminate it. If corrective action does not eliminate the hazard, warning signs should be posted, safety equipment should be installed and utilized, and safety procedures should be established to minimize the hazard. Another important part of maintaining safe working conditions is continued education of all plant personnel in safety procedures.

The remaining items discussed in this section are OSHA requirements as outlined in the Code of Federal Regulations (CFR) 29, Part 1910.120, Paragraph [E]. HLA and its subcontractors will comply with these safety guidelines during plant operation.

6.1 SAFETY TRAINING REQUIREMENTS

To ensure an understanding of and adequate protection against the potential hazards involved, all site personnel will have participated in a safety training class that meets OSHA standards (29 CFR, Part 1910.120, Paragraph [E]). Site personnel include engineers, geologists, technicians, and onsite supervisors. HLA is not responsible for training subcontractor employees. HLA will require proof of 40-hour OSHA training, annual updates, supervisor's training, and medical evaluation for all subcontractor personnel onsite. Site visitors will be accompanied by a person who has completed safety training, but visitors will not be permitted inside the Exclusion Zone (Section 6.5.3) unless they have completed a hazardous materials training course which meets OSHA requirements.

At a minimum, the safety training required by HLA addresses the following topics:

- General overview of toxicology and hazard evaluation
- Overview of toxic properties of the hazardous materials possibly present at the site

- Overview of health and advisory limits and occupational standards
- Discussion/demonstration of environmental monitoring equipment to be employed
- Discussion/demonstration/practical session with the PPE to be used in the event of a leak or spill
- Discussion of site entry and site control practices and requirements
- Discussion of decontamination procedures to be employed in the event of a leak or spill
- Discussion of contingency planning and emergency response
- Discussion of field activities to be conducted and potential hazards relative to each
- Practical session with safety, PPE, and decontamination procedures

Training requirements for all personnel will be a 40-hour safety course and a minimum of three days of on-the-job training under the direct supervision of a trained and experienced supervisor. All managerial personnel will be required to attend an additional eight-hour specialized training course specifically for management of hazardous waste operations. Attendance at the 40-hour safety course can be waived only if the individual has previous documented experience in hazardous waste site work equivalent to the 40-hour safety course. All personnel will be required to attend an eight-hour annual refresher course. Records and certifications will be maintained for all personnel attending the classes.

Additionally, at least one onsite HLA employee will have completed a CPR and first aid course.

6.2 MEDICAL MONITORING

All HLA field employees will receive a yearly comprehensive medical evaluation to qualify for hazardous waste site assignments. These employees receive exit medical examinations at the termination of their employment with HLA. Medical records of HLA employees are kept on file at HLA's Denver, Colorado, office or at the office of the examining physician. HLA is not responsible for subcontractor medical monitoring; however, subcontractors are expected to monitor their employees according to OSHA standards.

Medical monitoring will include a medical and work history for each employee. The fitness of the employee to wear required PPE for site work will be determined. The examining physician will be given a copy of OSHA Regulations 29 CFR 1910.120, employee duty description, anticipated exposure levels, PPE to be used, and any applicable information from previous medical examinations. A copy of the examining physician's written opinion of the employee's fitness for hazardous duty will be given to the employee.

Additional medical examinations will be conducted on the basis of work performed, reported illnesses, injuries, exposures, and recommendations from HLA's consulting physician.

6.3 SAFETY PLAN IMPLEMENTATION AND MODIFICATION

Before any activities begin on or around the site, a meeting will be held with all site personnel to discuss safety procedures and to familiarize personnel with the potential hazards of the site. Any changes in the HSP will be discussed with the DHSO before being implemented at the site. All site personnel will be informed both verbally and by written memorandum of any and all changes.

The HSO will conduct inspections of the site on a frequent and regular basis. If any operation, practice, or equipment does not pass inspection, the HSO will notify the DHSO and will have the authority to cease operations and/or remove faulty equipment. Unacceptable practices and/or faulty equipment will be remedied immediately, and the HSP will be modified to correct any deficiencies in the effectiveness of the plan.

6.4 STANDARD OPERATING PROCEDURES

The following Standard Operating Procedures (SOPs) have been developed to minimize hazards to site personnel. The HSO has authority on all day-to-day health and safety issues.

- Eating, drinking, smoking, and/or chewing tobacco, or chewing gum in the Exclusion Zone and Contamination Reduction Zone (CRZ) are prohibited. It is also prohibited inside the treatment plant.
- The number of personnel in the Exclusion Zone will be limited to the minimum necessary to complete the required work action. No visitors without adequate safety training will be permitted inside the Exclusion Zone.

- Entrance to the Exclusion Zone will be permitted only to personnel in proper PPE and with a "buddy." The "buddy system" will also be in effect at any work zone where respirators are being worn.
- While in the Exclusion Zone, all personnel will avoid contact with objects or soils/liquids unless the contact is necessary.
- Eyewash units and emergency showers will be located as near the source of hazard as physically possible.
- Smoking and other means of ignition (e.g., sparking equipment) will be prohibited in the work area, inside the plant, and wherever flammable liquids are present.
- If ambient air concentrations exceed 100 ppb for hydrazine, an alarm will sound. The site will be evacuated until concentrations have dropped to background again or until provisions have been made for self-contained breathing apparatus (SCBA) respiratory protection.

6.5 SITE CONTROL AND ACCESS

6.5.1 Site Security

Entrance to RMA is controlled by 24-hour guard stations located at the west and south property boundaries. The gates in the fence surrounding the treatment plant will be locked on evenings and weekends when O&M personnel are not present. Both the RMA Facilities Manager and the RMA Fire Department will have keys for the treatment facility in the event of an emergency.

6.5.2 Site Access

Access to the treatment facility will be restricted to RMA, HLA, and OHM personnel, authorized subcontractors, and authorized visitors. All personnel will be required to sign in and sign out at the treatment facility office.

6.5.3 Exclusion Zone

As discussed above and in the SOPs, no person without adequate safety training will be permitted to enter the Exclusion Zone. This area is defined as the area inside the double-fenced east and west tank yards of the HBSF. The Exclusion Zone will be clearly marked to prevent

unauthorized entry. Anyone entering this area will be required to don appropriate PPE. The locations of the Exclusion Zone and other important features at the HBSF are shown on Figure 3-1.

6.5.4 Contamination Reduction Zone

Before exiting the Exclusion Zone, personnel will remove and/or decontaminate PPE as required in the CRZ. The CRZ will be located immediately outside the Exclusion Zone. Decontamination procedures are discussed further in Section 6.8.

6.6 AIR MONITORING

Permanent treatment plant air-monitoring stations will be installed inside and in the area surrounding the treatment plant, and HNu photoionization detectors will be utilized while personnel are onsite. The stations will monitor the air 24 hours a day. If at any time the monitoring equipment indicates a rise in ambient air concentrations above predetermined concentrations, all personnel will immediately exit the area (see Section 10.0). Re-entrance to the area will not be permitted until ambient air concentrations have returned to background levels or unless Level B PPE is employed.

Personal air samples from the breathing zone will be collected periodically throughout operation of the treatment plant.

6.7 CALIBRATION AND MAINTENANCE OF MONITORING EQUIPMENT

Calibration of the monitoring equipment will be performed at the beginning of each work day. Equipment will be calibrated and maintained by the HSO in accordance with maintenance and calibration procedures specified in the manufacturer's/owner's/operator's manual. Personal air-monitoring equipment will be calibrated by the DHSO.

6.8 PERSONAL PROTECTIVE EQUIPMENT AND DECONTAMINATION

Following a determination that no leaks are occurring during start-up operations, all plant activities will be conducted in Level D protection, which consists of work coveralls, steel-toed

boots, surgical gloves, hard hat, and safety glasses. Earplugs will be made available for use when noise levels are such that a normal conversation cannot be conducted between personnel standing 3 feet apart. If personnel must enter the Exclusion Zone (storage tank area) or work with uncontained potentially hazardous materials, Level B protection must be utilized. Level B consists of Tyvek suits, steel-toed boots, overboots, inner and outer gloves, hard hat, and either SCBA respiratory protection or use of a cascade system. In the event of an accidental spill or leak, Level B will also be employed. HLA's Standard Respiratory Protection Program is provided in Appendix C.

Any time Level B protection is used, all personnel so protected must go through a complete decontamination in the CRZ upon exit from the Exclusion Zone. Decontamination procedures will consist of:

- Washing outer PPE to remove gross contamination
- Removal and disposal of used PPE
- Showering prior to entrance to support facilities

Washtubs, brushes, water, and citric acid will be available for decontamination. All wash water will be collected and treated by the chemical oxidation treatment system before discharge. Used PPE will be placed in numbered and labeled barrels to be stored onsite.

6.9 FIRST AID MEASURES FOR OXIDANT EXPOSURE

All personnel will be familiar with first aid measures for a victim overcome from oxidant exposure. These measures are as follows:

- Take steps to protect yourself before attempting to rescue a victim.
- Don proper PPE.
- Once the victim is out of the contaminated area, he/she should be kept warm and quiet. Encourage the victim to remain still and rest. Keep the victim on his/her back with the head lowered.
- Summon medical help immediately.
- Remove any contaminated clothing and flush the exposed areas with water.

- Place an oxygen mask on the victim's face until coughing has discontinued.
- Mild irritation of the throat can be relieved with milk.
- Artificial resuscitation should be started immediately if the victim stops breathing. Mouth-to-mouth resuscitation is the preferred method.

The above first-aid procedures should be posted in a highly visible position in the plant.

6.10 SPILL CLEAN-UP PROCEDURES

In the event of an accidental spill of potentially hazardous materials, all personnel involved with clean-up will employ Level B PPE. The spilled material will be washed down with supplied water and will be collected in floor drains. This wash material will be collected and cycled through the treatment plant before discharge.

7.0 SAFETY EQUIPMENT

The following safety and PPE will be available during operation of the treatment plant:

- Real-time monitor for ambient hydrazine. An MDA TLD-1 ChemKey detector will be used. This unit will be calibrated for hydrazine but can also be used, with separate calibrations, for MMH and UDMH. The TLD-1 provides a continuous readout (updated every 15 seconds) of ambient hydrazine concentrations up to 1000 ppb, visual and audible alarms at concentrations exceeding 100 ppb, a strip chart recorder, and alarm terminals that will be connected to an audible and/or visual alarm.
- Real-time monitor for ambient ozone. An MDA TLD-1 ChemKey detector will be used. The alarm set point for ozone will be 100 ppb. Other features are as described above.
- Fire extinguishers. Two 2A:10B:C multi-purpose fire extinguishes will be available and conspicuously located.
- Safety shower/safety eyewash. A combination emergency shower/eyewash with auxiliary drench hose will be available.
- SCBA. Three Scott SCBAs, 2200 psi, 30-minute capacity will be available for emergency use during investigation and clean-up of leaks and spills. These SCBAs will be subject to monthly inspections (see Respiratory Protection Program in Appendix C).
- General use first aid kit, contents approved by HLA's consulting physician.
- Sorbent materials for containing and clean-up of liquid spills, with labeled drums for disposal of used sorbent and contaminated PPE.
- PPE. It is anticipated that all work at the pilot plant during start-up activities will be in Level B PPE. All personnel inside the facility will be required to use air-line respirators until air monitoring has determined that the treatment system is operating correctly and that no NDMA or hydrazines are present in the ambient air.

Following a determination that the treatment system is operating properly, routine operation and monitoring activities may be conducted in Level D PPE (work clothes). The following PPE will be available and will be worn as determined by the site safety officer:

- o Safety glasses, face shields, splash goggles
- o Tyvek coveralls
- o Saranex-coated Tyvek coveralls
- o Saranex-coated Tyvek aprons
- o Protective boot covers
- o Chemical-resistant gloves

Three complete Level B PPE ensembles will be available for use during investigation and clean-up of leaks and spills.

8.0 SAFETY OPERATING PROCEDURES

8.1 GENERAL

Safety operations procedures are intended to guide the treatment plant operator in the general safety aspects of operating and maintaining a chemical oxidation treatment plant. For specific details of treatment system safety, refer to the vendor operation and maintenance manual.

8.2 SAFETY MEETINGS

Prior to each day's treatment plant start-up, a safety meeting will be held to discuss previous plant operating problems and safety concerns. Items discussed in this meeting and personnel in attendance will be documented in the treatment plant daily log.

Safe work practices will be discussed with respect to the task to be accomplished each day.

Each task will be discussed in five steps:

1. Task - The job to be performed
2. Observe - Consider where, when, and how the job is to be performed
3. Prepare - Gather the information, material, and equipment needed for the job
4. Think - How the job will be performed, hazards involved, and the safest way to perform the job
5. Act - Accomplishing the job safely and efficiently

9.0 ACCIDENT INVESTIGATION, REPORTING, AND AUDIT PROCEDURES

9.1 ACCIDENT INVESTIGATION AND REPORTING

All accidents that affect the health or safety of HLA personnel and/or subcontractors, RMA personnel, and visitors will be investigated, and corrective actions will be taken to prevent similar accidents. Investigations will be conducted for all accidents that result in (but not limited to) fatalities, disability, property damage, fire, explosion, lost work time, treatment at a medical facility, examination by a medical doctor, nurse, or paramedic, or unexpected exposure to chemical agents or hazardous materials.

The accident/incident investigation report to be completed by the HSM will include, at a minimum, the following information:

1. Contractor and telephone number
2. Name and title of the person reporting
3. Date and time of the accident or incident
4. Location (e.g., Army installation, facility name, building number)
5. A brief summary of pertinent details, including type and quantity of material and type of operation
6. Cause, if known
7. Casualties (fatalities, disabling injuries, exposure to chemical or biological agents or radiation)
8. Details of any known chemical hazard or other hazardous material or contamination
9. Estimation of property damage, if applicable
10. Nature of the damage; effect on production, operations, training, or other activities
11. Actions taken to ensure safety and security
12. Other damage or injuries sustained
13. Whether or not a release was made to news media; if so, a copy of the published article or statement will be attached
14. Any indication of sabotage or espionage, including possible theft or loss of chemical agent or agent-filled munitions

15. Any other pertinent information, including causal factors, if they are known, and any possible political implications
16. Type of carrier, if one was involved
17. Whether assistance was required; if so, the nature of such assistance will be indicated

If a malfunction of equipment is involved, the Accident or Incident Report will contain the following information in addition to that listed above:

1. Equipment nomenclature
2. Quantity involved
3. Production lot number(s)
4. Availability of replacement equipment and time estimated to continue activity

This report will be submitted to the Interim Response Division of PMRMA. HLA will also complete an internal accident investigation form to be submitted to HLA's corporate industrial hygiene and safety office. A copy of this form is provided on pages 31A and 31B.

If an accident occurs, it will be reported immediately to the HSO who will notify the Task Manager and the HSM. Accident reports will be conducted as discussed above through an onsite investigation. The scene of the accident will be examined, and witnesses will be interviewed. Accidents of a nonserious nature (not resulting in or not likely to result in serious bodily harm or death) will be acted upon within five working days. Responses to accidents of a serious nature (serious injury or death, chemical releases, fire) will be immediate and will include notification of affected parties.

9.2 COMPLIANCE AND AUDIT PROCEDURES

Audits of onsite work practices, equipment, records, and personnel knowledge of health and safety issues identified in the HSP will be conducted, announced or unannounced. Formal audits will be conducted at least quarterly by the HSM. Infractions or violations of established health and safety procedures will be corrected immediately, and disciplinary action will be enforced where appropriate. Audit reports will be available for inspection. The HSO will be responsible

for monitoring health and safety on a daily basis. The HSM will be immediately notified regarding problems and questions.

HLA corporate industrial hygiene and safety staff will periodically conduct unannounced health and safety audits to check compliance. Frequency of the audits will be dependent on work activities and level of risk.



I. GENERAL DATA

Employee Name		Social Security No.	Sex	Case No.
Job Title		Age		Date of injury
Office	OT last week /hrs	Immediate Supervisor	Date Injury Reported	
Location of Injury (address; description of job site)				Date of Hire

II. MEDICAL DATA

A. Class of injury (check one only)

☐ Fatality ☐ Lost workday ☐ No lost time ☐ First aid only ☐ Other

B. Nature of injury (check all that apply)

<input type="checkbox"/> Amputation	<input type="checkbox"/> Contusion, bruise	<input type="checkbox"/> Fleshburn	<input type="checkbox"/> Hernia rupture	<input type="checkbox"/> Occupational disease
<input type="checkbox"/> Asphyxiation	<input type="checkbox"/> Cut, laceration, bruise	<input type="checkbox"/> Foreign body in eye	<input type="checkbox"/> Poisoning—systemic	<input type="checkbox"/> Other
<input type="checkbox"/> Burn, scald	<input type="checkbox"/> Dermatitis	<input type="checkbox"/> Fracture	<input type="checkbox"/> Pneumoconiosis	<input type="checkbox"/> Unclassified, not determined
<input type="checkbox"/> Burn (chemical)	<input type="checkbox"/> Dislocation	<input type="checkbox"/> Freezing, frostbite	<input type="checkbox"/> Radiation effects	
<input type="checkbox"/> Concussion	<input type="checkbox"/> Electric shock, electrocution	<input type="checkbox"/> Hearing loss or impairment	<input type="checkbox"/> Scratches, abrasions	
<input type="checkbox"/> Contagious, infectious disease		<input type="checkbox"/> Heat stroke, sunstroke	<input type="checkbox"/> Strains, sprains	

C. Part of Body Affected (check all that apply)

<input type="checkbox"/> Trunk (abdomen, back, chest, hips, pelvis, shoulder, other)	<input type="checkbox"/> Head and neck (ear, eye, face, mouth, scalp, skull, neck, other)	<input type="checkbox"/> Lower extremities (ankle, foot, knee, lower leg, thigh, toe, other)	<input type="checkbox"/> Upper extremities (upper arm, elbow, forearm, finger, hand, wrist, other)	<input type="checkbox"/> Body system (circulatory, digestive, genitourinary, hematologic, integumental, musculoskeletal, nervous respiratory, other)
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III. ACCIDENT ANALYSIS

A. Accident Type (check one only)

<input type="checkbox"/> Struck by	<input type="checkbox"/> Motor vehicle accident	<input type="checkbox"/> Overexertion	<input type="checkbox"/> Contact with chemical or toxic substance	<input type="checkbox"/> Inhalation of toxic substance
<input type="checkbox"/> Struck against	<input type="checkbox"/> Public transportation	<input type="checkbox"/> Contact with electric current	<input type="checkbox"/> Exposure to physical hazards (noise, UV radiation)	<input type="checkbox"/> Other
<input type="checkbox"/> Fall from elevation	<input type="checkbox"/> Rubbed or scraped	<input type="checkbox"/> Contact with temperature extremes		<input type="checkbox"/> Caught in, under, or between
<input type="checkbox"/> Fall to foot level	<input type="checkbox"/> Bodily reaction			

B. Source of injury (check all that apply)

<input type="checkbox"/> Air pressure	<input type="checkbox"/> Clothing, apparel, shoes	<input type="checkbox"/> Floors, level surface	<input type="checkbox"/> Machines	<input type="checkbox"/> Soaps, detergents, cleaning compounds
<input type="checkbox"/> Animals, insects, birds, reptiles	<input type="checkbox"/> Coal and petroleum products	<input type="checkbox"/> Furniture, fixtures, furnishings	<input type="checkbox"/> Mission apparatus	<input type="checkbox"/> Silicates
<input type="checkbox"/> Animal products (not food)	<input type="checkbox"/> Cold (atmospheric, environmental)	<input type="checkbox"/> Glass items	<input type="checkbox"/> Metal (plate, sheet, coil)	<input type="checkbox"/> Scrap, wastes, debris
<input type="checkbox"/> Body motion	<input type="checkbox"/> Conveyors, uncovered (chutes, rollers, etc.)	<input type="checkbox"/> Hand tools, not powered	<input type="checkbox"/> Noise, vibration	<input type="checkbox"/> Steam
<input type="checkbox"/> Boilers, heating equipment, pressure vessels	<input type="checkbox"/> Dollies, hand trucks	<input type="checkbox"/> Heat (atmospheric, environmental)	<input type="checkbox"/> Paper, plastic, foil	<input type="checkbox"/> Textile items
<input type="checkbox"/> Boxes, barrels, containers, packages	<input type="checkbox"/> Drugs and medicines	<input type="checkbox"/> Hoisting apparatus	<input type="checkbox"/> Particulate (undefined)	<input type="checkbox"/> Tooling and fixtures
<input type="checkbox"/> Building and structures	<input type="checkbox"/> Electrical apparatus	<input type="checkbox"/> Infectious, parasitic agents	<input type="checkbox"/> Plants, trees, vegetation	<input type="checkbox"/> Vehicles, powered
<input type="checkbox"/> Ceramic items	<input type="checkbox"/> Excavations, trenches, tunnels	<input type="checkbox"/> Ladders, scaffolds	<input type="checkbox"/> Plastic items	<input type="checkbox"/> Wood items (pulp, lumber, slabs, chips)
<input type="checkbox"/> Chemicals (liquids, solids, gases, vapors, fumes, etc.)	<input type="checkbox"/> Flame, fires, smoke	<input type="checkbox"/> Liquids	<input type="checkbox"/> Pumps, prime movers	<input type="checkbox"/> Working surfaces
			<input type="checkbox"/> Radiating substances, equipment	<input type="checkbox"/> Work area environments
				<input type="checkbox"/> Other

C. Unsafe Act (check all that apply)

<input type="checkbox"/> Horseplay	<input type="checkbox"/> Working on energized, pressurized equipment	<input type="checkbox"/> Failure to follow instructions	<input type="checkbox"/> Operating or acting without authorization or in unauthorized location	<input type="checkbox"/> Inattention to footing or surroundings
<input type="checkbox"/> Failure to secure, warn, lockout, or assure clearance	<input type="checkbox"/> Misuse of equipment, tools, materials, vehicles	<input type="checkbox"/> Failure to use proper personal protective	<input type="checkbox"/> Taking an unsafe bodily position or posture (climbing, reaching, stretching)	<input type="checkbox"/> Using unsafe equipment
<input type="checkbox"/> Improper lifting or carrying	<input type="checkbox"/> Driver/operator error	<input type="checkbox"/> Improper use of hands or body parts	<input type="checkbox"/> Failure to wear safe personal attire	<input type="checkbox"/> Removing or making safety devices inoperative
<input type="checkbox"/> Improper task selection	<input type="checkbox"/> Failure to use equipment provided or	<input type="checkbox"/> Unsafe placing, mixing, loading		<input type="checkbox"/> Other

D. Unsafe Condition (check all that apply)

<input type="checkbox"/> Poor housekeeping	<input type="checkbox"/> Inadequate illumination	<input type="checkbox"/> Natural hazards (terrain, elements, etc.)	<input type="checkbox"/> Unavailability of required equipment or devices
<input type="checkbox"/> Guarding not provided	<input type="checkbox"/> Inadequately designed ventilation	<input type="checkbox"/> Hazardous conditions	<input type="checkbox"/> No hazardous condition
<input type="checkbox"/> Inadequate traffic control, traffic hazards	<input type="checkbox"/> Unsuitable design construction, layout of prescribed work method	<input type="checkbox"/> Inadequate or improper guarding	<input type="checkbox"/> Improper stackings, palletizing, and bending
<input type="checkbox"/> Defects of machines, equipment, tools, materials, vehicles		<input type="checkbox"/> Other	

E. Supervisory Conditions (check all that apply)

<input type="checkbox"/> Failure to enforce safety rules, standards, or procedures	<input type="checkbox"/> Failure to follow instructions	<input type="checkbox"/> Inadequate training or instruction provided	<input type="checkbox"/> Other ineffective immediate supervision	<input type="checkbox"/> Failure to provide correct or safe tools
<input type="checkbox"/> Inadequate inspection of equipment or work	<input type="checkbox"/> Incorrect job assignment, layout, or design	<input type="checkbox"/> Failure to provide appropriate personal protective equipment		

DESCRIPTION OF ACCIDENT

A. Names of witnesses

B. How did accident happen? (Give a brief description)

C. Why did accident occur? (Explain more fully any unsafe acts/conditions which contributed to this accident).

D. Was the person(s) involved in the accident aware of the safe procedures to complete the job? Describe

E. Who is responsible for corrective action and when is the expected completion date?

Investigated by:

Date:

Reviewed by DHSO:

Date:

Reviewed by Project Manager:

Date:

Reviewed by Manager M/S:

Date:

Copies to: Project Manager, Office Manager, DHSO, Corporate Health and Safety Manager

10.0 EMERGENCY PROCEDURES

10.1 LEAKS AND SPILLS

The pilot plant will be equipped with a real-time hydrazine monitor, which will activate an audible alarm within 15 minutes when ambient air concentrations of hydrazine exceed the Threshold Limit Value (TLV) of 0.1 ppm. If this occurs during daytime plant operation hours, all nontask individuals, e.g., visitors, regulatory personnel, and auditors, will be required to immediately leave the area. Plant operation personnel will immediately proceed to the office/support area and don an SCBA, Tyvek, boot covers, and gloves. No attempts to locate or correct the source or leak will be made without first donning an SCBA. The HLA Task Manager, the HSM, and the PMRMA Task Manager will be notified immediately. If the alarm sounds when the plant is unattended (e.g., evenings, weekends), the audible/visual alarm located at the facility will be activated. RMA personnel will be instructed to immediately contact one of several people, including the HLA Task Manager, HSM, and the PMRMA Task Manager. As necessary, the manufacturer of the pilot plant equipment will be contacted to assist in correction of the leak.

Spills and leaks of feedstock liquids or treated liquids will be handled in the same manner. Use of supplied air/SCBA is mandatory, as is the use of protective booties, Saranex-coated Tyvek, gloves, and goggles. Sorbent materials will be used to control, contain, and collect the liquids. This sorbent material will be stored in labeled drums for disposal. Because all spills or leaks represent a potentially serious or recurring problem, the HLA Task Manager, HSO, and HSM will be notified immediately. A written report will be prepared for all spills and leaks to address the cause, effect, and corrective action taken. This report will be prepared by the Start-up Engineer and will be reviewed by the HLA Task Manager, the HSM, and the PMRMA Task Manager.

10.2 EXPLOSIONS

In the event of an explosion, facility personnel will immediately notify the RMA Fire Department. Account for all personnel known to be onsite. Do not attempt to administer first

aid to an injured individual without first addressing the risk to yourself and providing for your own protection. This may require donning an SCBA prior to entering the treatment facility. Other hazards that may be present include the potential for additional explosions, fire, and unsafe structural elements. If there is any question regarding the safety of the facility, evacuate immediately and wait for assistance from the RMA Fire Department.

10.3 PERSONAL INJURIES AND MEDICAL EMERGENCIES

Minor injuries should be treated with supplies maintained in the first aid kit. Paramedic support is available from the RMA Fire Department. All injuries and medical emergencies resulting in lost time or examination by a paramedic doctor, nurse, or other health provider must be reported to the Task Manager and the HSM. A formal investigation will be conducted and will be documented in a report.

10.4 EMERGENCY COMMUNICATIONS

The facility telephone will be available for emergency use. A hand-held walkie-talkie for direct contact with the RMA Fire Department will also be available.

11.0 SUBCONTRACTOR SAFETY EVALUATION

HLA will review all subcontractor safety plans to ensure that these plans meet all the requirements and guidelines specified by law.

12.0 SHIPPING PROCEDURES

The following procedures have been designed to meet the packaging and shipping requirements set forth in the CFR Chapter 49, Parts 100-177, Transportation, and CFR Chapter 40, Part 261.4(e), Treatability Study Samples.

12.1 STEPS FOR COMPLYING WITH APPLICABLE SHIPPING REGULATIONS

1. Determination of Proper Shipping Name. The shipper must determine the proper U.S. Department of Transportation (DOT) shipping name of the materials per the Hazardous Materials Table, Section 172.101, Column 2, in CFR Chapter 49, Parts 100-199. Samples sent for testing will be identified as Hydrazine, Aqueous Solutions.
2. Determination of Hazard Class. Referring to the Hazardous Materials Table, Section 172.101, Column 3, locate the hazard class of the material. The hazard class associated with Hydrazine, Aqueous Solutions, is Corrosive Material.
3. Selection of Proper Identification Number.
 - a. Refer to the Hazardous Materials Table, Section 172.101, Column 3(a) and select the identification number (ID) that corresponds to the proper shipping name and hazard class. For Hydrazine, Aqueous Solutions, the identification number is ID No. UN2030.
 - b. Enter the ID number(s) on the shipping papers and display them, as required, on the shipping packages.
4. Mode of Transportation.
 - a. Samples are to be shipped overnight via Federal Express. Complete the "Shippers Certification for Restricted Articles Dangerous Goods." A copy of a properly completed Federal Express shipping paper is found on page 38A.
 - b. Prior to release to Federal Express, check to see that the shipment meets the requirement for (1) packaging, (2) quantity per package, (3) marking, (4) labeling, (5) shipping papers, and (6) certification.
5. Determination of Proper Packaging
 - a. Refer to the Hazardous Materials Table, Section 172.101, Column 5(a) for exceptions and Column 5(b) for authorized packagings. Consider the following when selecting an authorized container: quantity per package; cushioning material, if required; proper closure and reinforcement; proper pressure; outage; etc., as required.
 - Overpack Container. All sample containers are to be placed inside a strong outside shipping container. A metal cooler (ice chest) lined inside with hard plastic complies with the DOT drop test requirement. Care must be taken to secure the drainage hole at the bottom of the cooler. The lid should fit tightly to prevent leakage if the container is accidentally overturned.

- Collect sample in an amber glass container (1 liter) with a nonmetallic, Teflon-lined screw cap. To prevent leakage, fill container no more than 90 percent full at temperatures up to 130°F. If air space in the sample container would affect sample integrity, place that container within a second container to meet 90 percent requirement.
 - Secure sample bottle lids with electrical tape and evidence tape.
 - Mark volume level on the bottle with grease pencil.
 - Labels/Sample Tags. The sample must be tagged or labeled with the date, time of collection, site name, and brief description on a water-impervious label. Use only indelible ink on all labels and tags. Cover labels with wide clear plastic tape.
 - Place the sample container inside 2-mil-thick (or thicker) ziplock polyethylene bag, one sample per bag. Seal the bag.
 - Place sealed bag inside metal (paint type) can and cushion it with enough noncombustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other means to securely seal the can lid.
 - Label the can with appropriate DOT hazard class label and laboratory address.
 - Place approximately 1 inch of packing material in bottom of cooler.
 - Place cans in cooler and fill remaining volume of cooler with packing material.
 - Put paperwork (chain-of-custody and request for analysis form) in a plastic bag and tape the bag with masking tape to inside lid of cooler.
 - Tape cooler drain shut.
 - Tape cooler completely around with strapping tape at two locations. Secure lid by taping. Do not cover any labels.
 - Affix custody tape/seals on front right and back left of cooler, cover with wide clear tape.
6. Selection of Proper Shipping Labels. Refer to the Hazardous Materials Table, Section 172.101, Column 4 for required label(s). For Hydrazine, Aqueous Solutions, the "Corrosive" label must be used. Apply to outside of packaging.
7. Marking of Overpack Packaging. The top of the overpack packaging is to display the following labels (Section 172.300) and wording. Do not use abbreviations unless specified.
- Proper shipping name and ID number (Section 172.301)
 - Appropriate DOT hazard class label(s) ("Corrosive")
 - "This Side Up"

- "Laboratory Sample for Analysis"
- Laboratory Address (Section 172.306)
- "Fragile" (if containing glass)
- "Limited Quantity (LTD QTY)" (when using Limited Quantity exception)
- "Cargo Aircraft Only"
- "Inside Packages Comply with Prescribed Specifications"

NOTE: Labels should not overlap. Leave room for airbill.

The sides of the outer container are to display "This Side Up" arrows and the proper DOT Hazard Class labels on two adjacent sides.

NOTE: If Proper Shipping Name (PSN) and United Nations (UN) Number are not printed on margin of DOT label, write them on label or wide tape and place on side of cooler.

8. Certification. Each shipper must certify by printing (manually or mechanically) on the shipping papers that the materials being offered for shipment are properly classified, described, packaged, marked, and labeled and are in proper condition for transportation according to the applicable DOT regulations (Section 172.204).
 - a. Fill in the appropriate Federal Express account number, your name, and street address (P.O. Box is not acceptable) the samples are being shipped from. You must include the accurate zip code.
 - b. Fill in the current date, recipient's name, company, and street address where the samples are to be delivered. Include an accurate zip code. You must include a phone number if samples are designated "hold for pick-up" or delivered on Saturday.
 - c. Fill in "notes/reference numbers" (for example, project name and/or number). Check payment block ("Bill Shipper").
 - d. Check "Priority 1" (Restricted Articles should be shipped Priority 1/Overnight). Check the delivery service required (usually "deliver"). If "hold for pick-up" or "Saturday delivery" is required, be sure to include a phone number in Section 2.
 - e. Fill in number of packages, weight (up to 70 pounds allowed), and totals.
 - f. "No. of pkgs." means inner packages containing a restricted article (i.e., paint can). Remember that in the definition of overpack, the cooler is not considered a packaging.
 - g. Fill in the Proper Shipping Name (PSN), Classification (Hazard Class), and Identification Number. Do not abbreviate.

At the bottom of this section write "Laboratory Samples for Analysis."

- h. The "Net Quantity Per Package" means the amount of material (sample) per package (paint can). You may also give a total material (sample) per overpack. Check the

Hazardous Materials Table, 49 CFR Part 172.101, Column 6, for limitation on quantity to be shipped by cargo aircraft. Delete the nonapplicable designation.

- i. Print the name and title of the person signing (and taking responsibility for) the certification. Fill in the phone number where that person can be reached and sign the certification.

9. Documentation/Paperwork.

- Chain-of-Custody Record. The HLA-approved chain-of-custody form must be included in each outer container. Be sure to indicate nature of hazard in appropriate section. A copy of an HLA Chain-of-Custody record is found on page 38B.

EXPRESS

USE THIS AIRBILL FOR DOMESTIC SHIPMENTS WITHIN THE CONTINENTAL U.S., ALASKA AND HAWAII.
DO NOT USE FOR PUERTO RICO OR INTERNATIONAL DESTINATIONS.
COMPLETE PURPLE AREAS. SEE BACK OF AIRBILL FOR MORE INSTRUCTIONS.
QUESTIONS? CALL 800-238-3333 TOLL FREE.

AIRBILL
NUMBER

9406463043

9406463043



Sender's Federal Express Account Number		Date	
		5/9/89	
From (Your Name) Please Print		Your Phone Number (Area Code)	
MICHAEL D. KLEIN		(303) 894-9878	
Company		Department/Floor No.	
HARDING LAWSON ASSOCIATES			
Street Address			
1301 PENNSYLVANIA, SUITE 200			
City	State	ZIP Required For Correct Mailing	
DENVER	CO	80203	
To (Recipient's Name) Please Print		Recipient's Phone Number (Area Code)	
SAMPLE RECEIVING		(704) 544-5570	
Company		Department/Floor No.	
ETC MULTITECH			
Exact Street Address (Use of P.O. Boxes or P.O. Box Cities Will Cause Delivery And Address To Carry Charge)			
320 TESCONI CIRCLE SUITE L			
City	State	ZIP Street Address To Receive	
SANTA ROSA	CA	95401	

YOUR BILLING REFERENCE INFORMATION (FIRST 24 CHARACTERS WILL APPEAR ON INVOICE)

20003,520.10

PAYMENT ☒ By Sender ☐ By Recipient's Federal Express No. ☐ By 3rd Party Federal Express No. ☐ By Credit Card

SERVICES CHECK ONLY ONE BOX		DELIVERY AND SPECIAL HANDLING CHECK SERVICES REQUIRED		PACKAGES	WEIGHT	YOUR DECLARED VALUE	TYPE
1 PRIORITY 1 Overnight Delivery using your Packaging. When using ICAO requirements, please mark appropriate boxes. Do not mark for CFR 175. <input type="checkbox"/> Cargo Aerial only <input checked="" type="checkbox"/> Dangerous Goods Air Transport Declaration <input checked="" type="checkbox"/> Dangerous Goods Transport Declaration 5 STANDARD AIR Economy rate using your packaging. Business day only.		1 HOLD FOR PICK-UP Not in business hours. 2 DELIVER WEEKDAY Not in business hours. 3 DELIVER SATURDAY Extra charge. 4 DANGEROUS GOODS ICAO and IATA regulations apply. Extra charge. 5 CONSTANT SURVEILLANCE SERVICE (CSS) Extra charge. Not for combination use.		1	1.00	100.00	1
7 OTHER SPECIAL SERVICE 8 SATURDAY PICK-UP Extra charge.		6 DRY ICE Not in business hours.		2	1.00	100.00	2
SERVICE COMMITMENT PRIORITY 1: Carrier's guarantee that your shipment will arrive within 1 business day of your shipping date. If it does not, you will receive a refund of the shipping charge. STANDARD AIR: Carrier's guarantee that your shipment will arrive within 2 business days of your shipping date. If it does not, you will receive a refund of the shipping charge.		9 SATURDAY PICK-UP Extra charge.		3	1.00	100.00	3
				4	1.00	100.00	4
				5	1.00	100.00	5
				6	1.00	100.00	6
				7	1.00	100.00	7
				8	1.00	100.00	8
				9	1.00	100.00	9
				10	1.00	100.00	10

HOLD FOR PICK-UP AT THIS FEDERAL EXPRESS LOCATION: (Use Address - See Service Guide or Call 800-238-3333)

Federal Express will deliver to your address.

YOUR DECLARED VALUE

DAMAGE OR LOSS

There is a charge of \$100.00 per \$100.00 of value for damage or loss. The charge is based on the actual value of the goods. The charge is not applicable if the goods are insured by the shipper. The charge is not applicable if the goods are insured by the carrier. The charge is not applicable if the goods are insured by the shipper and the carrier.

DELAY

There is a charge of \$100.00 per \$100.00 of value for delay. The charge is based on the actual value of the goods. The charge is not applicable if the goods are insured by the shipper. The charge is not applicable if the goods are insured by the carrier. The charge is not applicable if the goods are insured by the shipper and the carrier.

CONSEQUENTIAL DAMAGES

There is a charge of \$100.00 per \$100.00 of value for consequential damages. The charge is based on the actual value of the goods. The charge is not applicable if the goods are insured by the shipper. The charge is not applicable if the goods are insured by the carrier. The charge is not applicable if the goods are insured by the shipper and the carrier.

DO NOT SHIP CASH OR CURRENCY

9406463043

AIRBILL NUMBER

SHIPPER'S CERTIFICATION FOR RESTRICTED ARTICLES/DANGEROUS GOODS

CHECK ONE ☒ 49 CFR ☐ ICAO

(TYPE OR PRINT)

NO. OF PKGS.		DANGEROUS GOODS IDENTIFICATION		TOTAL		PACKING INSTRUCTIONS		AUTHORIZATION	
1		Hydrazine, Aqueous Solution. For Laboratory Analysis		1 Liter		49CFR 173.276			
CLASS OR DIVISION		UN2030		N/A					
SUBSIDIARY RISK									

ADDITIONAL DESCRIPTION REQUIREMENTS FOR RADIOACTIVE MATERIALS (SEE BACK)	RADIOACTIVE MATERIALS	FORM	ACTIVITY	CATEGORY OF LABELS TRANS	INDEX	PACKAGE IDENTIFICATION

TRANSPORT DETAILS	THIS SHIPMENT IS WITHIN THE LIMITATIONS PRESCRIBED FOR	PASSENGER AIRCRAFT	CARGO AIRCRAFT ONLY	(DELETE-NONAPPLICABLE)
AIRPORT OF DEPARTURE	AIRPORT OF DESTINATION	SHIPMENT TYPE	NON-RADIOACTIVE	(DELETE-NONAPPLICABLE)
Denver/Stapleton				

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS OR TREATMENT.

I HEREBY DECLARE THAT THE CONTENTS OF THIS CONSIGNMENT ARE FULLY AND ACCURATELY DESCRIBED ABOVE BY PROPER SHIPPING NAME AND ARE CLASSIFIED, PACKED, MARKED, AND LABELED, AND ARE IN ALL RESPECTS IN PROPER CONDITION FOR TRANSPORT BY AIR ACCORDING TO THE APPLICABLE INTERNATIONAL AND NATIONAL GOVERNMENT REGULATIONS.

NAME AND TITLE OF SHIPPER	PLACE AND DATE
DAY (303)894-9878	
Signature of Shipper	

SEE WARNING ON BACK

CHAIN OF CUSTODY FORM

Job Number: _____

Name/Location: _____

Project Manager: _____

Recorder: _____

(Signature Required)

[illegible][illegible]

CHAIN OF CUSTODY RECORD

[illegible]

form	number	volume
Actio, Conflicto, Defensio	Actio, Conflicto, Defensio	Actio, Conflicto, Defensio

11

13.0 WASTE DISPOSAL PROCEDURES

13.1 GENERAL

All waste generated by this task will be stored or accumulated in containers that meet DOT requirements. All containers will be inspected, numbered, and assigned a hazardous waste container log (HWCL) documenting the contents of each container. A copy of the HWCL is found on page 40A.

Packaging/container specifications are outlined in CFR Chapter 49, Parts 178 and 179. These specifications will be followed.

13.2 INSPECTIONS

All containers in use that store or accumulate hazardous wastes will be inspected at least once each weekday or once each day of operation. The containers will be checked for corrosion, leakage, overpressurization, container collapse, and presence/condition of warning signs and labels.

13.3 MARKINGS

All containers used onsite will be labeled to indicate:

- "Hazardous Waste"
- The date on which the waste material started accumulation
- A unique container identification number stenciled onto the container

13.4 HAZARDOUS WASTE CONTAINER LOG

The HWCL provides documentation that clearly identifies the chemical composition of waste material being stored in containers.

This form is properly completed when information is present to clearly, completely, and legibly identify:

1. The date the container is placed into active service
2. The identification number of the container for which the HWCL identifies waste addition

3. The location to which the container is deployed and where waste materials were added
4. The name of the person responsible for maintenance of the container and the HWCL
5. The location to which the contents of the container were transferred when it was removed from the location identified in No. 3 above
6. The date of waste transfer
7. Information that completely documents the accumulation of waste in the container, including:
 - Common chemical name
 - Volume of waste material added
 - Date of waste material addition
 - Name of the person responsible for each waste addition

NOTE: Estimates for waste materials added to containers should be as accurate as possible. The goal of this documentation is to provide reasonable information describing the composition and quantity of each waste material.

13.5 CONTAMINATED WASTE DISPOSAL

Containerized materials will be transferred to the RMA contractor in charge of waste management.

13.6 DISPOSAL OF TREATED LIQUIDS BY CHEMICAL OXIDATION PROCESS

The treated liquids will be stored and sampled for applicable standards. Prior to disposal in the RMA sewer system, the liquids will be treated to meet these standards.

14.0 SAFETY PERMITS

Safety permits are not expected to be necessary for operation of the treatment facility. However, to comply with an Army data item regarding safety permits, it should be noted that both HLA and OHM internal safety permitting systems will be used throughout construction and operation of the treatment facility.

15.0 SYSTEM SAFETY HAZARD ANALYSIS REPORT

A Safety System Hazard Analysis Report (SSHAR) will be prepared for the treatment system and facility decommissioning. The SSHAR is prepared to systematically identify and evaluate both real and potential hazards and to document procedures for elimination or control of these hazards. The SSHAR will be submitted as a separate report. As the SSHAR is an integral part of the health and safety program, the preparation guidelines are included in this HSP. Although MIL-STD-882A is the referenced guidance document, the updated reference MIL-STD-882B, effective March 30, 1984, will be used as guidance for preparation of the SSHAR.

The SSHAR will consist of two sections: (1) a preliminary hazard analysis (PHA) and (2) a system hazard analysis (SHA).

15.1 PRELIMINARY HAZARD ANALYSIS

The PHA will be initiated early in the planning phase. Because data may be incomplete and informal, the PHA may undergo continual revision and updating. The PHA will include, at a minimum, the following information:

1. A review of pertinent historical safety experience
2. A categorized listing of basic energy sources
3. An investigation of the various energy sources to determine the provisions developed for their control
4. Identification of the safety requirements and other regulations pertaining to personnel safety, environmental hazards, and toxic substances to which the system must comply
5. Recommend corrective actions

A subsystem hazard analysis will not be performed because the wastewater treatment plant is considered to be a stand-alone system.

15.2 SYSTEM HAZARD ANALYSIS

The SHA will begin as the treatment system design matures and will be updated until the design is complete. Specifically, the SHA will examine the system for:

1. Compliance with safety criteria
2. Possible combinations of independent or dependent failures that can cause hazards to the system or personnel; failures of controls and safety devices should be considered
3. How normal operations of systems and subsystems can degrade the safety of the system
4. Design changes to system, subsystems or interfaces, logic, and software that can create new hazards to equipment and personnel

16.0 AIR SAMPLING

Air sampling for the presence of hydrazine fuels, NDMA, and certain volatile organic compounds will be conducted to evaluate the integrity of the full-scale treatment system during start-up and to document any personnel exposures. During the first week of start-up operation, daily samples will be collected and submitted for analysis on a 24-hour turnaround basis. The 24-hour turnaround is necessary to evaluate the integrity of the system and to become aware of any leaks as soon as possible so that repairs and/or modifications may be made. Air sampling will also be required whenever plant operations change such that an increased risk of exposure may be expected.

During this start-up phase, all personnel will be required to utilize a supplied breathing air system. Specific air-sampling procedures are presented in the following sections.

16.1 N-NITROSODIMETHYLAMINE

The ThermoSorb/N Air Sampling System developed by Thermedics will be utilized for NDMA air sampling. The ThermoSorb/N System uses a two-part sampling apparatus to avoid artifact formation.

Nitrogen oxides can easily react with amines to form nitrosamines. To avoid this formation, ThermoSorb Air Samplers contain an artifact trap that includes an amine-trapping agent and a nitrosation inhibitor. To prevent UV light degradation of the collected nitrosamines, the sampling systems are constructed of unbreakable, opaque plastic.

Two area samples will be collected each day. Standard personal air sampling pumps will be used to draw the ambient air into the sampling cartridge. Each pump will be calibrated each day before sampling begins. Pumps will not be recalibrated after each sampling period, as only the presence or absence of NDMA needs to be determined. The error in sampling flow rate would be acceptable even if it were greater than the ± 5 percent recommended by the National Institute for Occupational Safety and Health (NIOSH).

Samples will be sent by overnight mail to the Thermedics Analytical Laboratory for analysis. After five consecutive samples report nondetectable concentrations of NDMA, the use of supplied air will be no longer be mandatory.

During the remainder of the pilot plant operation, two samples per day, two days per week, will be collected and submitted to Thermedics Analytical Laboratory for analysis. A 24-hour turnaround analytical time will be requested.

16.2 HYDRAZINE FUELS

Samples for hydrazine fuels will be collected according to NIOSH Method 248, which involves drawing a measured volume of air through a tube containing silica gel to trap the hydrazines. Two area samples will be collected each day as long as daily NDMA samples are collected. Pumps will be calibrated both before and after sampling. Samples will be sent to Hagar Laboratories in Englewood, Colorado, for 24-hour turnaround analysis.

The NIOSH method will serve as a verification of the real-time hydrazine monitor, the MDA TLD-1. The TLD-1 is a colorimetric detection system based on the change in light reflection from a hydrazine-reactive paper strip. When daily hydrazine samples are no longer necessary, two hydrazine samples will be collected per day, two days per week, for the remainder of the pilot plant operation.

All personnel at the plant, including operators and visitors, will be required to wear a personal hydrazine dosimeter at all times. These will be available from commercial sources and/or the Naval Research Laboratory.

16.3 OZONE

If ozone is used as an oxidant, a second MDA TLD-1 monitor will provide 24-hour real-time monitoring for ozone. The alarm level will be set at 100 ppb, which is the TLV and the Permissible Exposure Level (PEL) for ozone. The ozone monitor will be operating continuously throughout the duration of the pilot plant operation.

17.0 LIST OF ACRONYMS AND ABBREVIATIONS

ARARs	- Applicable or Relevant and Appropriate Requirements
CFR	- Code of Federal Regulations
CPR	- Cardiopulmonary Resuscitation
CRL	- Certified Reporting Limit
CRZ	- Contamination reduction zone
DHHS	- U.S. Department of Health and Human Services
DHSO	- Designated Health and Safety Officer
DOI	- U.S. Department of the Interior
DOJ	- U.S. Department of Justice
DOT	- U.S. Department of Transportation
EPA	- U.S. Environmental Protection Agency
FFA	- Federal Facility Agreement
HBSF	- Hydrazine Blending and Storage Facility
HLA	- Harding Lawson Associates
HSM	- Health and Safety Manager
HSO	- Onsite Health and Safety Officer
HSP	- Health and Safety Plan
HWCL	- Hazardous Waste Container Log
ID	- Identification Number
IRA	- Interim Response Action
IRA H	- RMA IRA Task 4 for HBSF, Phase I
LTD QTY	- Limited quantity
mg/l	- Milligram per liter
µg/l	- Microgram per liter
MIL-STD	- Military Standard

MMH	- Monomethyl hydrazine
MSDS	- Material Safety Data Sheets
NDMA	- N-nitrosodimethylamine
NIOSH	- National Institute for Occupational Safety and Health
O&M	- Operation and Maintenance
OHM	- OHM Corporation (O.H. Materials Corporation)
OSHA	- U.S. Occupational Safety and Health Administration
PEL	- Permissible exposure level
PHA	- Preliminary hazard analysis
PMRMA	- Program Manager for Rocky Mountain Arsenal
ppb	- Parts per billion
PPE	- Personal protective equipment
PSN	- Proper shipping name
RMA	- Rocky Mountain Arsenal
SCBA	- Self-contained breathing apparatus
SHA	- System hazard analysis
SOP	- Standard Operating Procedure
SSHAR	- Safety System Hazard Analysis Report
TLV	- Threshold Limit Values
TWA	- Time-Weighted Average
UDMH	- Unsymmetrical dimethyl hydrazine
UN	- United Nations
UV	- Ultraviolet

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Appendix A
HAZARDOUS PROPERTY INFORMATION

HAZARDOUS PROPERTY INFORMATION
EXPLANATIONS AND FOOTNOTES

- a. Water solubility is expressed in grams per 100 grams water at 20°C (e.g., 0.2g means 0.2 grams per 100 grams water at 20°C).
- b. Flash points in Fahrenheit. Several chlorinated hydrocarbons exhibit no flash point in the conventional sense but will burn in the presence of a high-energy ignition source or will form explosive mixtures at temperatures above 200°F.
- c. TLV-TWA (Threshold Limit Value - Time Weighted Average) adopted by the American Conference of Governmental Industrial Hygienists. (Benzene TWA established by OSHA.)
- d. Hazard property
 - A - corrosive
 - B - flammable
 - C - toxic
 - D - volatile
 - E - reactive
 - F - radioactive
 - G - carcinogen
 - H - infectious
 - I - explosive
 - J - suspected carcinogen
- e. Acute exposure symptoms
 - A - abdominal pain
 - B - central nervous system depression
 - C - comatose
 - D - convulsions
 - E - confusion
 - F - dizziness
 - G - diarrhea
 - H - drowsiness
 - I - eye irritation
 - J - fever
 - K - headache
 - L - nausea
 - M - respiratory system irritation
 - N - skin irritation
 - O - tremors
 - P - unconsciousness
 - Q - vomiting
 - R - weakness
 - S - anorexia
 - T - temperature sensitivity
- f. Solubility of metals depends on the compound in which they are present.
- g. Explosive concentrations of airborne dust can occur in confined areas. This is not expected to occur during this investigation.

Table 1: Hazardous Property Information

Material	Water Solubility(a)	Specific Gravity	Vapor Density	Flash Point(b)	Vapor Pressure @ 20C	LEL/UEL (%)	TLV(c) (ppm)	IDLH Level (ppm)	Hazard Property(d)	Acute Exposure Symptoms(e)
CONTAMINANT COMPOUNDS										
Chloroform	Slightly	1.485	-	-	160mm	NA	10	1000	CDG	BCEGIKLMN
Citric Acid	Soluble	1.542	-	-	-	-	-	-	B	-
1,1-Dichloroethane	0.19	1.174	8.4	22°	182mm	6/16	200	4000	BCD	ABHIHNO
1,1-Dichloroethene	Insoluble	1.282	3.4	39°	591mm	7.3/16.0	5	-	BCDG	BIHN
Dimethylcyanamide	-	0.876	-	160°	-	-	-	-	BC	-
N-N-Dimethylformamide	Soluble	0.954	-	136°	1mm	1.2/unknown	10	3500	B	ACLOS
Hydrazine	Slightly	0.874	1.6	5°	25mm	2/95	0.1	-	BGI	DIMQ
Hydrogen peroxide	Soluble	-	-	-0.41°C	5mm	Unknown	1	75	BCI	IMN
Monomethyl hydrazine	Soluble	0.874	-	70°	36mm	2.5/98	0.2	-	BIJ	BFILN
n-Nitrosodimethylamine	Soluble	1.006	-	142°	5mm	-	0	-	BG	ACJKLQ
Methylene chloride	Slightly	0.83	2.9	NA	350mm	12/-	100	-	CED	BCIKLMNPR
Oxygen	Soluble	1.1053	1.429	None	-	NA	None	None	B	None
Ozone	Soluble	1.6 (liquid)	-	-310°C	>1atm	NA	0.1	10	BCI	M
Sodium hypochlorite	Soluble	-	-	-	-	-	-	-	BC	IMN
Tetrachloroethane	Slightly	1.595	5.8	NA	5mm	NA	1	100	C	B
Unsymmetrical dimethyl hydrazine	Soluble	0.782	-	5°	103mm	2/95	0.5	-	BIJ	BFILN
PESTICIDES										
Endrin	Insoluble	-	-	-	10 mm	3.8/21	0.1mg/m³	200mg/m³	CIJ	ADFKLQ
1-Ethyl 1H 1,2,4-triazole	No available hazard information									
Lindane	-	1.85	-	-	0.32 mm	-	0.5mg/m³	1000mg/m³	CG	BIHN
Methoxychlor	Insoluble	-	-	-	-	HA	10mg/m³	7500mg/m³	C	None

Table 1: (Continued)

Material	Water Solubility ^(a)	Specific Gravity	Vapor Density	Flash Point ^(b)	Vapor Pressure	LEL/UEL (%)	TLV ^(c) (ppm)	IDLH Level (ppm)	Hazard Property ^(d)	Acute Exposure Symptoms ^(e)
PESTICIDES (Continued)										
Toraphene	Insoluble	1.66	-	-	0.40 mm	-	0.5mg/m ³	200mg/m ³	C	DELNO
2,4,5-TP (silvex)	Slightly	-	-	-	-	-	10mg/m ³	5000mg/m ³	C	N
METALS										
Arsenic	Insoluble	5.72	NA	NA	NA	NA	0.2mg/m ³	NA	CEG	ACDGJHOOR
Cadmium	Insoluble	8.64	NA	NA	NA	NA	0.05mg/m ³	40mg/m ³	C	ABGHIKLMNOR
Chromium	Insoluble	7.1	NA	NA	NA	NA	0.05mg/m ³	500mg/m ³	CG	FHHQ
Lead	Insoluble	11.35	NA	NA	NA	NA	0.05mg/m ³	Variable	C	ACDFGKOOR
Mercury	Insoluble	13.59	7.0	0.0012mm	0.0012mm	NA	50ug/m ³	28mg/m ³	C	AGLMNQ
Selenium	Insoluble	4.5	-	-	-	-	0.2mg/m ³	100mg/m ³	C	IHN
Silver	Insoluble	10.5	NA	None	NA	NA	0.01mg/m ³	None specified	C	IN

Appendix B
MATERIAL SAFETY DATA SHEETS



OCEAN® Network

EMERGENCY PHONE 1-800-OLIN-911

MATERIAL
SAFETY DATA

SECTION I - IDENTIFICATION

MSDS FILE 704

CHEMICAL NAME & SYNONYMS 1,1-dimethyl hydrazine: UDMH		
CHEMICAL FAMILY Hydrazine	FORMULA (CH ₃) ₂ NNH ₂	PRODUCT UDMH
DESCRIPTION Colorless liquid with sharp ammoniacal odor		CAS NO. 57-14-7

SECTION II - NORMAL HANDLING PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE May be fatal if swallowed. Avoid contact with eyes, skin, clothing. Upon contact with skin or eyes, wash off with water. Avoid breathing mist or vapor. Protect against physical damage. Outside or detached storage is preferred. Inside storage should be in a standard flammable liquid storage room or cabinet. Separate from oxidizing materials. Tanks should be located in a diked area. Protect against electrical sparks, open flames.	
PROTECTIVE EQUIPMENT	VENTILATION REQUIREMENTS
EYES Goggles or face shield	As required to keep airborne concentrations below the TLV.
GLOVES Butyl rubber	
OTHER Coveralls, boots and butyl rubber apron	

SECTION III - HAZARDOUS INGREDIENTS

BASIC MATERIAL	OSHA PEL	LD50	LC50	SIGNIFICANT EFFECTS
1,1-dimethylhydrazine	0.5 ppm (skin)	122 mg/kg (oral-rat)	1410 ppm 1 hr (rat)	Suspect carcinogen. Corrosive to eyes, skin and mucous membranes. Respiratory distress. Liver damage.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT 5°F CC METHOD	OSHA CLASSIFICATION Flammable liquid	FLAMMABLE EXPLOSIVE LIMIT	LOWER 2%	UPPER 55%
EXTINGUISHING MEDIA water and alcohol foam. Small fires can be extinguished with carbon dioxide and dry chemical.				
SPECIAL FIRE HAZARD & FIRE FIGHTING PROCEDURES Use NIOSH/MSHA approved positive pressure self-contained breathing apparatus when any material is involved in a fire. Wear a butyl rubber encapsulated suit when fighting a fire involving this material.				

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE 0.5 ppm TWA (skin) (ACGIH 1987-88)
SYMPTOMS OF OVER EXPOSURE Dizziness, nausea, corrosive to eyes, skin and mucous membranes, CNS depression. May cause temp. blindness. Damage to lungs, liver, kidneys, blood.
EMERGENCY FIRST-AID PROCEDURES
SKIN Immediately flush with water for 15 minutes. call a physician.
EYES Immediately flush with water for 15 minutes. call a physician.
INGESTION Immediately drink large quantities of water. Induce vomiting by sticking finger down throat. call a physician.
INHALATION Immediately remove victim to fresh air. call a physician.

PRODUCT CODE 134072

CHEMICAL NAME UDMH

SECTION VI - TOXICOLOGY (PRODUCT)

ACUTE ORAL LD 50 122 mg/kg (rats) May be fatal if swallowed. CARCINOGENICITY Suspect carcinogen (NTP)
 ACUTE DERMAL LD 50 MUTAGENICITY Mutagenic
 1.049 g/kg (rabbit) EYE IRRITATION Corrosive
 ACUTE INHALATION LC 50 1410 ppm inspired air 1 hr (rat) PRIMARY SKIN IRRITATION Corrosive

PRINCIPAL ROUTES OF ABSORPTION

Inhalation, dermal contact, eye contact, ingestion.

EFFECTS OF ACUTE EXPOSURE Corros. to eyes, skin, mucous memb., temp. blindness, dizziness, nausea, CNS depr. Damage to liver, lungs, kidneys, blood and blood forming organs.

EFFECTS OF CHRONIC EXPOSURE Carcinogenic in laboratory animals. May cause effects on blood leading to anemia. May affect liver, kidney and central nervous system.

SECTION VII - SPILL AND LEAKAGE PROCEDURES (CONTROL PROCEDURES)

ACTION FOR MATERIAL RELEASE OR SPILL

Remove all sources of ignition. Wear NIOSH/MSHA approved positive pressure supplied air respirator or self-contained breathing apparatus. Follow OSHA regulations for respirator use (see 29 CFR 1910.134). Wear goggles, butyl rubber gloves, boots and slicker suit. Isolate area of spill by diking. Stop source of leak. Transfer contents to a non-leaking container or storage vessel. Neutralize spill by first diluting hydrazine to a 5% or less concentration. Then add an equal amount of a 5% or less concentration of a hypochlorite solution to totally neutralize the hydrazine. Test for neutralization. After neutralization, transfer this material to an approved DOT container for proper disposal. Wash all contaminated clothing before reuse. In the event of a large spill, call the emergency telephone number shown on the front of this sheet.

TRANSPORTATION EMERGENCY CONTACT CHEMTREC 800-424-9300

Dispose of contaminated product, empty containers and materials used in cleaning up spills or leaks in a manner approved for this material. Consult appropriate Federal, State and local regulatory agencies to ascertain proper disposal procedures.

SECTION VIII - SHIPPING DATA

D.O.T. Unsymmetrical dimethyl hydrazine, flammable liquid UN 1163 Poison

SECTION IX - REACTIVITY DATA

STABLE x UNSTABLE AT C F

HAZARDOUS
POLYMERIZATIONMAY OCCUR
WILL NOT OCCUR y

CONDITIONS TO AVOID May spontaneously ignite in air when spread on large surface, heat, ignition sources of any kind.

INCOMPATIBILITY (MATERIAL TO AVOID)

Oxidizing agents

HAZARDOUS DECOMPOSITION PRODUCTS

Nitrosamines, ammonia, hydrogen

SECTION X - PHYSICAL DATA

MELTING POINT -71°F	VAPOR PRESSURE 1.0 psi @ 40°F	VOLATILES 100%
BOILING POINT 147°F	SOLUBILITY IN WATER Miscible	EVAPORATION RATE No data
SPECIFIC GRAVITY (M20=1) .784	PH No data	VAPOR DENSITY (AIR=1) 2.14

INFORMATION: FURNISHED TO

FURNISHED BY DATE MARCH 29, 1988
 Olin MSDS Control Group
 (203) 356-3449

ATTN: DEPT HANDLING MATL SAFETY DATA SHEETS
 GARY ANDERSON
 HARDING LAWSON ASSOC.
 1301 PENNSYLVANIA ST.
 SUITE 200
 DENVER CO80203

Olin CORPORATION
 120 Long Ridge Road, Stamford, Connecticut 06904
 OCEAN® Network
 EMERGENCY PHONE 1-800-OLIN-911



OCEAN® Network

EMERGENCY PHONE 1-800-OLIN-911

MATERIAL SAFETY DATA

SECTION I - IDENTIFICATION

MSDS FILE 238

CHEMICAL NAME & SYNONYMS Monomethyl Hydrazine, Methyl Hydrazine		
CHEMICAL FAMILY hydrazine	FORMULA CH_3NNH_2	PRODUCT Monomethyl Hydrazine
DESCRIPTION Clear, colorless, hygroscopic liquid with amine-like odor		CAS NO. 60-34-4

SECTION II - NORMAL HANDLING PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE Fatal if swallowed. Avoid contact with eyes, skin or clothing. Upon contact with skin or eyes, wash off with water. Avoid breathing mist or vapor. Store in a well ventilated area under nitrogen atmosphere away from heat, sparks, open flames, and oxidants. Do not contaminate. Keep container closed when not in use. Drums should be vented carefully when opening. All containers should be electrically grounded.	
PROTECTIVE EQUIPMENT	VENTILATION REQUIREMENTS
EYES Goggles	As required to keep airborne concentrations below the TLV.
GLOVES Butyl rubber	
OTHER Coveralls, butyl rubber boots and apron	

SECTION III - HAZARDOUS INGREDIENTS

BASIC MATERIAL	OSHA PEL	LD50	LC50	SIGNIFICANT EFFECTS
Monomethyl hydrazine	0.2 ppm ceiling (skin)	33 mg/kg (rat)	74 ppm 4 hrs. (rat)	Carcinogenic in Lab animals, damage to major organs, corrosive to skin, eyes and mucous membranes. Liver damage. May cause fetal malformations.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT 70° F CDC METHOD	OSHA CLASSIFICATION Flammable Liquid	FLAMMABLE EXPLOSIVE LIMIT	LOWER 4.5%	UPPER 36%
EXTINGUISHING MEDIA Dry chemical, carbon dioxide, water spray. Flood with water to prevent ignition and to keep fire-exposed containers cool.				
SPECIAL FIRE HAZARD & FIRE FIGHTING PROCEDURES Use NIOSH/MSHA approved positive pressure self-contained breathing apparatus when any material is involved in a fire. Wear butyl rubber encapsulated suit when fighting a fire involving this material.				

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE Methyl hydrazine: 0.2 ppm ceiling, (skin) (ACGIH 1987-88), considered a suspect human carcinogen by ACGIH.
SYMPTOMS OF OVER EXPOSURE Dizziness, nausea, corrosive to eyes, skin and mucuous membranes, CNS depression. May cause temp. blindness. Damage to lungs, liver, kidneys, blood.
EMERGENCY FIRST-AID PROCEDURES
SKIN Immediately flush thoroughly with water for 15 minutes, call a physician.
EYES Immediately flush with water for 15 minutes, call a physician.
INGESTION Immediately drink large quantities of water. Induce vomiting by sticking finger down throat. Call a physician.
INHALATION Immediately remove victim to fresh air. Call a physician.

PRODUCT CODE 134075

CHEMICAL NAME Monomethyl hydrazine

SECTION VI - TOXICOLOGY (PRODUCT)

ACUTE ORAL LD 50 33 mg/kg (rat). Fatal if
swallowed
ACUTE DERMAL LD 50
183 mg/kg (rabbit)
ACUTE INHALATION LC 50 74 ppm for 4 hours
(rat)

CARCINOGENICITY Carcinogenic in animal studies-NTP
MUTAGENICITY Positive
EYE IRRITATION Corrosive
PRIMARY SKIN IRRITATION
Corrosive

PRINCIPAL ROUTES OF ABSORPTION

Dermal contact, inhalation, ingestion, eye contact.

EFFECTS OF ACUTE EXPOSURE Corr. to eyes, skin, muc. membranes, temp. blindness, dizziness, nausea,
CNS depr. Damage to liver, lungs, kidney, blood and blood forming organs

EFFECTS OF CHRONIC EXPOSURE CNS depr., damage to liver, lungs, kidney, blood forming organs, skin
sensit. and dermatitis. May cause fetal abnormalities. Suspect human carcinogen

SECTION VII - SPILL AND LEAKAGE PROCEDURES (CONTROL PROCEDURES)

ACTION FOR MATERIAL RELEASE OR SPILL

Remove all sources of ignition. Wear NIOSH/MSHA approved positive pressure supplied air
respirator or self-contained breathing apparatus. Follow OSHA regulations for respirator use (see
29 CFR 1910.134). Wear goggles, butyl rubber gloves, boots and slicker suit. Isolate area of
spill by diking. Stop source of leak. Neutralize spill by first diluting hydrazine to a 5% or
less concentration. Then add an equal amount of a 5% or less concentration of a hypochlorite
solution to totally neutralize the hydrazine. Test for neutralization. After neutralization,
transfer this material to an approved DOT container for proper disposal. Wash all contaminated
clothing before reuse. In the event of a large spill, call the emergency telephone number shown
on the front of this sheet.

TRANSPORTATION EMERGENCY, CONTACT CHEMTREC 800-424-9300

Dispose of contaminated product, empty containers and materials used in cleaning up spills or
leaks in a manner approved for this material. Consult appropriate Federal, State and local
regulatory agencies to ascertain proper disposal procedures.

SECTION VIII - SHIPPING DATA

D.O.T. Methyl Hydrazine - Flammable Liquid UN 1244 Poison

SECTION IX - REACTIVITY DATA

STABLE x UNSTABLE AT C F

HAZARDOUS
POLYMERIZATION

MAY OCCUR

WILL NOT OCCUR y

CONDITIONS TO AVOID

High heat

INCOMPATIBILITY(MATERIAL TO AVOID) Hydrogen peroxide, nitrogen tetroxide, fluorine, halogen
fluorides, fuming nitric acid, oxidizing agents.

HAZARDOUS DECOMPOSITION PRODUCTS

NH₃, Nitrogen oxides, carbon monoxide

SECTION X - PHYSICAL DATA

MELTING POINT -52.4° C	VAPOR PRESSURE 37.5 mmHg	VOLATILES No data
BOILING POINT 37.5° C	SOLUBILITY IN WATER Miscible	EVAPORATION RATE No data
SPECIFIC GRAVITY(H ₂ O=1) 0.8738	PH No data	VAPOR DENSITY(AIR=1) 1.6
Viscosity: 0.885 cP @20°C	Density: 0.874 g/ml @25°C	

INFORMATION: FURNISHED TO

FURNISHED BY DATE SEPTEMBER 20, 1986
Olin MSDS Control Group
(203) 356-3449

ATTN: DEPT HANDLING MATL SAFETY DATA SHEETS
GARY ANDERSON
HARDING LAWSON ASSOC.
1301 PENNSYLVANIA ST.
SUITE 200
DENVER CO80203

Olin CORPORATION
120 Long Ridge Road, Stamford, Connecticut 06904
OCEAN® Network
EMERGENCY PHONE 1-800-OLIN-911



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MATERIAL SAFETY DATA

SECTION I - IDENTIFICATION

MSDS FILE 2395

CHEMICAL NAME & SYNONYMS Hydrazine Solution 5%		
CHEMICAL FAMILY Hydrazine	FORMULA $N_2H_4 \cdot H_2O$	PRODUCT SCAV-OX® PLUS LPB 5%
DESCRIPTION Clear colorless liquid with odor of ammonia		CAS NO. 302-01-2

SECTION II - NORMAL HANDLING PROCEDURES

PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE Harmful if swallowed. Do not get in eyes, on skin or on clothing. Upon contact with skin or eyes, wash off with water. Avoid breathing mist or vapor. Discard any contaminated leather articles. Store in a cool, dry, well-ventilated area away from oxidizing materials, acids or ignition sources. Avoid exposure to direct sunlight or high temperatures.	
PROTECTIVE EQUIPMENT	VENTILATION REQUIREMENTS
EYES Goggles	As required to keep airborne concentrations of hydrazine below TLV
GLOVES Butyl rubber	
OTHER Coveralls, boots and butyl rubber apron	

SECTION III - HAZARDOUS INGREDIENTS

BASIC MATERIAL	OSHA PEL	LD50	LC50	SIGNIFICANT EFFECTS
*Hydrazine (5%) CAS No.: 302-01-2	0.1ppm TWA (skin)	91 mg/kg dermal (rabbit)	570 ppm/4 hrs (rat)	Carcinogenic in laboratory animals. Damage to major organs. Irritant to skin, eyes and mucous membranes. May cause fetal malformations.

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT >200°F CEC METHOD	OSHA CLASSIFICATION Not regulated	FLAMMABLE EXPLOSIVE LIMIT	LOWER NO	UPPER NO
EXTINGUISHING MEDIA Water. Hydrazine solution concentrated by heat can liberate vapors (explosive limits of hydrazine 4.7-100%). Flood with water to fight fire.				
SPECIAL FIRE HAZARD & FIRE FIGHTING PROCEDURES Use NIOSH/MSHA approved positive pressure self-contained breathing apparatus when any material is involved in a fire. Wear butyl rubber encapsulated suit when fighting a fire involving this material.				

SECTION V - HEALTH HAZARD DATA

THRESHOLD LIMIT VALUE Hydrazine (skin) 0.1 ppm TWA (ACGIH 1988-89)
SYMPTOMS OF OVER EXPOSURE Dizziness, nausea, skin, eye and mucous membrane irritation. CNS depression. Damage to liver/lungs/kidneys/blood. May cause fetal malformations.
EMERGENCY FIRST-AID PROCEDURES Immediately remove all contaminated clothing. Flush with water for 15 minutes, call a SKIN physician.
EYES Immediately flush with water for 15 minutes, call a physician.
INGESTION Immediately drink large quantities of water. Induce vomiting by sticking finger down throat. Call a physician.
INHALATION Immediately remove victim to fresh air, call a physician.

PRODUCT CODE 134006

CHEMICAL NAME SCAV-OX® PLUS LPS 5%

SECTION VI - TOXICOLOGY (PRODUCT)

ACUTE ORAL LD 50 Approx 3000 mg/kg (rat).
Harmful if swallowed.
ACUTE DERMAL LD 50
2700 mg/kg (rabbit)
ACUTE INHALATION LC 50
No available data

CARCINOGENICITY Carcinogenic - animal studies (NTP)
MUTAGENICITY Positive
EYE IRRITATION Irritant
PRIMARY SKIN IRRITATION
Irritant

PRINCIPAL ROUTES OF ABSORPTION
Inhalation, skin contact

EFFECTS OF ACUTE EXPOSURE CNS depression, dizziness, nausea. May cause damage to lungs, liver, kidneys and blood. Irritant to skin, eyes and mucous membranes.

EFFECTS OF CHRONIC EXPOSURE May cause damage to liver, lung, kidneys and blood, dermatitis, allergic sensitization. May cause fetal malformations. Suspect human carcinogen.

SECTION VII - SPILL AND LEAKAGE PROCEDURES (CONTROL PROCEDURES)

ACTION FOR MATERIAL RELEASE OR SPILL

Wear goggles, butyl rubber gloves, boots and coveralls. For spills indoors or involving hot material wear a positive pressure supplied air respirator or self-contained breathing apparatus. Follow OSHA regulations for respirator use (see 29 CFR 1910.134). Isolate area of spill by diking. Stop source of leak. Transfer contents to non-leaking container or storage vessel. Neutralize spill by first diluting hydrazine to a 5% or less concentration. Then add an equal amount of a 5% or less concentration of a hypochlorite solution to totally neutralize the hydrazine. Test for neutralization. After neutralization transfer this material to an appropriate container for proper disposal. Wash all contaminated clothing before reuse. In the event of a large spill, call the emergency telephone number shown on the front of this sheet.

TRANSPORTATION EMERGENCY, CONTACT CHEMTREC 800-424-9300

THE MIXTURE OR TRADE NAME PRODUCT HEREIN CONTAINS A TOXIC CHEMICAL(S) SUBJECT TO THE REPORTING REQUIREMENTS OF SECTION 313 OF TITLE III OF THE SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT OF 1986 AND 40 CFR PART 372. THE SARA 313 CHEMICALS ARE LISTED IN SECTION III AND ARE INDICATED BY AN ASTERISK (*).

SECTION VIII - SHIPPING DATA

D.O.T. ORM-A N.O.S. (Contains Hydrazine) NA 1693

SECTION IX - REACTIVITY DATA

STABLE x UNSTABLE AT C F

HAZARDOUS
POLYMERIZATION

MAY OCCUR

WILL NOT OCCUR y

CONDITIONS TO AVOID

Concentration of solution by evaporation.

INCOMPATIBILITY (MATERIAL TO AVOID) Will react with oxygen, oxidants, metal oxides, aqueous metal salts and strong acids.

HAZARDOUS DECOMPOSITION PRODUCTS

Ammonia, hydrogen

SECTION X - PHYSICAL DATA

MELTING POINT No data	VAPOR PRESSURE No data	VOLATILES No data
BOILING POINT No data	SOLUBILITY IN WATER Complete	EVAPORATION RATE No data
SPECIFIC GRAVITY (H ₂ O=1) No data	PH *See below	VAPOR DENSITY (AIR=1) No data
	*OH 1% sol 10.1-10.7	

INFORMATION: FURNISHED TO

FURNISHED BY DATE MAY 1, 1989

Olin MSDS Control Group
(203) 356-3449

ATTN: DEPT HANDLING MATL SAFETY DATA SHEETS
GARY ANDERSON
HARDING LAWSON ASSOC.
1301 PENNSYLVANIA ST.
SUITE 200
DENVER CO80203

Olin CORPORATION
120 Long Ridge Road, Stamford, Connecticut 06904
OCEAN® Network
EMERGENCY PHONE 1-800-OLIN-911

MATERIAL SAFETY DATA SHEET
GENTUM PUBLISHING CORPORATION
 1145 CATALYN ST., SCHENECTADY, NY 12303 USA (518) 377-8854



MSDS # 533

CITRIC ACID

Issued: April, 1985

Revised:

From Gentium's MSDS Collection, to be used as a reference.

SECTION 1. MATERIAL IDENTIFICATION

MATERIAL NAME: CITRIC ACID, Anhydrous, USP

Other designations: 3-Hydroxytricarballic Acid, 2 hydroxy-1,2,3 - propanetricarboxylic Acid, $C_6H_8O_7$;
 CAS #000 077 929.

Manufacturer: Suppliers include: Pfizer Chemicals Div. and Allied Chemical Company
 235 E. 42nd Street PO Box 2219
 New York, NY 10017 Columbus, OH 43216
 (201) 546-7221 (614) 889-3333

SECTION 2. INGREDIENTS AND HAZARDS

Citric Acid

99.5

No exposure limits have been established.

Rabbit, skin:

500 mg/24hr:

moderate irritation.

Rabbit, eye:

0.75 mg/24 hr:

Severe irritation.

Rat, oral:

LD50: 11700 mg/kg.

SECTION 3. PHYSICAL DATA

Melting Point, - 153°C

Density (18/4 C) - 1.665 g/ml

Solubility in Water @ 20°C - 59.2 g/100ml

Molecular Weight - 192.14

Appearance & Odor: White granules or powder. Odorless.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
N/A	1000 - 1020°C			

Extinguishing Media: Water, fog, CO₂ or dry chemical.

Firefighters should wear self-contained breathing apparatus with a full facepiece.

SECTION 5. REACTIVITY DATA

This material is stable at room temperature under normal storage and use conditions. It melts at 153°C, and at 175°C begins to convert to various organic compounds (aconitic acid, acetonedicarboxylic acid, acetone) with the evolution of carbon dioxide.

Aqueous solutions of citric acid can be mildly corrosive to carbon steels, but does not attack stainless steel.

As an organic acid, this material will react with bases. Contact with strong alkalis should be avoided.

SECTION 6. HEALTH HAZARD INFORMATION

TLV None established.

Citric acid occurs naturally in the body as a metabolite in the tricarboxylic acid (Krebs) cycle. It is an approved general purpose food additive. Although this material is not considered to present a significant industrial health hazard, excessive exposure may result in irritation of the eyes, skin, and mucous membranes of the respiratory tract.

FIRST AID:

EYE CONTACT: Flush eyes, including under the eyelids, with large amounts of water. If irritation persists, get medical attention (In-plant, Paramedics, Community).

SKIN CONTACT: Wash effected area with soap and water. If irritation persists, seek medical attention.

INHALATION: Remove person to fresh air.

INGESTION: If substantial quantities are ingested, rinse mouth and give person 2 or 3 glasses of milk or water to drink. Seek medical attention (In-plant, Paramedic, Community).

SECTION 7. SPILL, LEAK AND DISPOSAL PROCEDURES

For powder spills, carefully scoop up material into a suitable container. For spills of aqueous solutions of Citric Acid, neutralize spill with Sodium Bicarbonate. Scoop up slurry into a suitable container. Flush area with copious amounts of water. Clean-up personnel should wear approved respiratory protection, rubber gloves and goggles to prevent irritation from contact and/or inhalation.

DISPOSAL: Solid waste may be packaged in paper or dissolved in a flammable solvent and burned in an approved incinerator. Follow local, State and Federal regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide adequate general and local ventilation to control dust levels to no more than the nuisance dust TLV (ACGIH: 10 mg/m³; OSHA: 15 mg/m³). If the material is melted, additional ventilation may be required to control vapors.

A NIOSH-approved respirator and safety goggles should be worn where dusting occurs, especially above the nuisance dust TLV. Gloves are recommended when prolonged or repeated contact is likely.

Provide eyewash stations in work areas where eye contact is possible.

Contact lenses pose a special hazard; soft lenses may absorb and all lenses concentrate irritants.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in a cool dry area. Protect containers from physical damage.

DATA SOURCE(S) CODE (See Glossary) 1, 4, 11, 54, 55.

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APPROVALS

DO. Accross 4/85

INDUST. HYGIENE/SAFETY

JW 7-85

MEDICAL REVIEW:

JW 8/85

MATERIAL SAFETY DATA SHEET

Essentially similar to OSHA Form 20

SECTION I - MANUFACTURER'S NAME / ADDRESS

Degussa Corporation, 65 Challenger Road, Ridgely Park, New Jersey 07660

 Chemical Name: **HYDROGEN PEROXIDE 20% to 52% in Aqueous Solution** CAS #: **7722-84-1**

Trade Name & Synonyms:

 Synonyms: **Peroxide, hydrogen dioxide**

 Chemical Family: **Inorganic Peroxide**

 Formula: **H₂O₂**
SECTION II - HAZARDOUS INGREDIENTS

Name	CAS #	%	TLV (Units)	Name	CAS #	%	TLV (Units)
HYDROGEN PEROXIDE	7722-84-1	20-52	1ppm				
	<i>OSHA PEL</i>	<i>=</i>	<i>1 ppm</i>				

SECTION III - PHYSICAL DATA

Boiling Point (°F)	220-237	Specific Gravity (H ₂ O = 1)	1.2
Vapor Pressure (mmHg.)	18-25	Percent Volatile by Volume (%)	approx. 100
Vapor Density (AIR = 1)	approx. 1.0	Evaporation Rate (Butyl Acetate = 1)	more than 1
Solubility in Water	Complete	Decomposition Temperature (°F)	NA

 Appearance and Odor: **Clear, colorless liquid with a slightly pungent odor.**

NOTICE: The data contained herein is based on information that Degussa believes to be reliable, but no expressed or implied warranty is made with regard to the accuracy of such data or its suitability for a given situation. Such data relates only to the specific product described and not to such product in combination with any other product and no agent of Degussa is authorized to vary any of such data. Degussa Corporation and its agents disclaim all liability for any actions taken or foregone on reliance upon such data.

Peroxygen Chemicals Department

65 Challenger Road Ridgely Park NJ 07660 201-641-6100 Telex 134445 T'WX 710-990-6143

HYDROGEN PEROXIDE

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

Flash Point (Closed Cup):	Non-flammable	Flammable Limits:	NA	Le: NA

Extinguishing Media: Use water to fight fires in which this material is involved. Wear self-contained breathing apparatus and full body protection. Apply vast amounts of water for cooling and dilution.

Special Fire Fighting Procedures: Do not use fire fighting agents other than water.

Unusual Fire & Explosion Hazards: Spontaneous combustion can occur if allowed to remain in contact with oxidizable materials. Drying of product on clothing or combustible materials may cause fire. Do not allow temperature of storage tanks to rise above 100°F. Do not heat solution to concentrate to 74% or greater.

SECTION V - HEALTH HAZARD DATA

Threshold Limit Value:	1 ppm	REL (OSHA):	NA	LD 50:	NA	LD 50:	NA
------------------------	-------	-------------	----	--------	----	--------	----

Effects of Overexposure (Acute & Chronic): Short term exposure: Causes irritation. May cause eye injury (effects may be delayed). Whitening of skin on contact. Longer exposure: Causes blisters or burns. If swallowed, may cause sudden formation of oxygen, which can cause injury by distention of the esophagus or stomach with local internal bleeding. Inhalation of vapor or mist may cause irritation or inflammation of upper air passages.

Emergency First Aid Procedures

Eyes: In case of eye contact, immediately flush eyes with plenty of water for at least 15 minutes. Get attention of ophthalmologist immediately.

Skin: Flush skin with copious amounts of water.

Respiratory: Administer oxygen. Consult physician. If breathing has stopped, administer artificial respiration. Clinically observe for 48 hours because of the possibility of pulmonary edema.

Ingestion: Drink plenty of milk or water immediately to dilute contents of stomach. Do not induce vomiting. Call physician.

Clothing: Remove and wash contaminated clothing and shoes thoroughly and promptly. Clothing may ignite spontaneously and burn fiercely if product dries out.

SECTION VI - REACTIVITY DATA

Stability	Stable	Conditions to Avoid: Contamination from any source may cause rapid decomposition, generation of large quantities of oxygen gas and high pressure.
-----------	--------	---

Incompatibility (Materials to Avoid): Heavy metals, organic materials, dust, reducing agents, dirt, alkali, rust.

Hazard Decomposition Products: Large quantities of oxygen will support combustion.

Hazardous Polymerization	Will Not Occur	Conditions to Avoid: NA
--------------------------	----------------	-------------------------

SECTION VII - SPILL OR LEAK PROCEDURES

Steps to be Taken in Case Material is Released or Spilled: Do not get in eyes. Wear goggles. Avoid contact with skin - wear neoprene, butyl rubber, or vinyl gloves. Eliminate source of spill and flood with vast amounts of water.

Waste Disposal Method (Including Neutralization): This material is a hazardous waste (as per RCRA) because of its reactivity. Disposal should be conducted by an EPA (RCRA) permitted disposer or an EPA (RCRA) permitted disposal facility.

SECTION VIII - SPECIAL PROTECTION INFORMATION

Respiratory Protection (Specify Type): Organic vapor/acid gas canister - SCBA during emergencies.

Ventilation	Local Exhaust: Maintain adequate ventilation	Special:
	Mechanical (General): To maintain concentrations below TLV.	Other:

Protective Gloves: Neoprene, butyl rubber or vinyl gloves Eye Protection: Chemical safety goggles or face shield.

Other Protective Equipment: Safety hat, neoprene safety shoes or boots. Full protective clothing. Safety showers and eye baths should be available in work area.

SECTION IX - SPECIAL PRECAUTIONS

Precautions to be Taken in Handling & Storage: Do not get in eyes. Avoid contact with skin. Store in original vented containers in dry location away from sun and heat or in dedicated bulk storage facilities. Protect from physical damage. Keep open lights, fire and sparks away from containers. Do not confine in unvented vessels or between closed valves.

Other Precautions: Never use pressure to empty. DO NOT RETURN THE MATERIAL TO THE CONTAINER AFTER BEING TAKEN OUT. Have large volumes of water available for washing down H_2O_2 spills.

HYDROGEN PEROXIDE

SECTION X - SHIPPING INFORMATION

Primary Hazard: **Oxidizer**

Secondary Hazard: **NA**



Proper DOT Shipping Name: **Hydrogen peroxide solution**

Hazard Class: **Oxidizer**

49 CFR Section Reference: **173.244 & 173.266**

Hazardous Substance? **No**

Reportable Quantity: **NA**

Label(s)	Placard(s)	UN Number	2014
		UN Class	5.1
		PG Number	II
		STCC Number	4918335
		NMFC Item	44640
		UFC Item	24020
		Shipping Restrictions:	
			Air - forbidden in concentrations of 40% or over. Below 40%:
			Passenger A/C 1 qt. max. Cargo only 1 gal. max.

Container/Packaging Data Authorized Container Type(s): **Drum - DOT Spec. 6D or 37M with inside liner DOT Spec. 2S or 2SL or DOT 34 (polyethylene drums), IM 101 Portable Tanks**

SECTION XI - EMERGENCY RESPONSE

Evacuation: For a decomposition problem inside a tank: **Evacuate the area and keep all unnecessary personnel away and to a safe distance of 2000 ft. in all directions.**

Containment - Immediate & Follow-up: **Contain and apply large amounts of water for dilution and eliminate ignition sources. Flush very dilute solution to drainage system.**

EMERGENCY RESPONSE CONTACT(S):

**Degussa Corporation
CHEMTREC**

Phone #:
**(205) 653-0632
(800) 424-9300**

SECTION XII - PRODUCT INFORMATION CONTACT(S)

Degussa Corporation	Contact(s): Product Manager Facility Superintendent	Address: Ridgefield Park, New Jersey Theodore, Alabama	Business Phone: (201) 641-6100 Business Phone: (205) 653-7933
---------------------	---	--	--

Date: 1/88

Prepared By: **PSCC
Product Safety Compliance Committee
Degussa Corporation**

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-3855



No. 62

OXYGEN

Date April 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: OXYGEN
DESCRIPTION: Supplied as compressed gas (2100 psig) in cylinders or as cold liquid in dewar containers.
OTHER DESIGNATIONS: O₂, CAS #007 782 447, GE D27A15
MANUFACTURERS: Available from several suppliers, including:
AIRCO, Inc. Union Carbide Corp.
Industrial Gases Div. Linde Corp.
275 Mountain Ave. Murray Hill, NJ 07974 270 Park Ave. NY, NY 10017
Telephone: 201 462-3100 Telephone: 212 512-1963

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Oxygen	> 99.5	No IDL established*
*The minimum oxygen content in workplace air is 18 vol % (ACGIH, 1979).		

SECTION III. PHYSICAL DATA

Boiling point, at 760 mm Hg, deg C	--- -183	Specific gravity at -183 C	----- 1.14
Vapor Pressure at -199 C, mm Hg	----- ca 100	Melting point, deg C	----- -218.4
Vapor density (Air=1)	----- 1.1	Viscosity, cpa, at 25 C	----- 0.0206
Solubility in water, cm ³ /100 g, at 25 C	3.16	Critical temperature, deg C	----- -118.3
Molecular weight	----- 32.00	Critical pressure, atm	----- 50.14

Appearance and Odor: Colorless gas, bluish liquid, or blue solid with hexagonal crystals, odorless, tasteless.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
N/A	N/A	N/A		
Extinguishing Media: Shut off O ₂ gas if possible and use media appropriate for the surrounding fire. Use water spray to cool fire-exposed containers. If feasible, remove oxygen containers from fire danger. Though not flammable itself, oxygen vigorously supports combustion. Materials which do not burn in air may burn in oxygen-enriched air. Materials can become spontaneously flammable at high oxygen levels. Oxygen release in a fire situation greatly increases fire and explosion hazards. (Oxygen cylinders have safety devices to release O ₂ at excessive temperature or pressure.) Liquid oxygen can explode on contact with flammables.				

SECTION V. REACTIVITY DATA

Oxygen is stable when kept isolated as a compressed gas in cylinders or as a cold liquid in vented, insulated containers. Stainless steel, aluminum, copper and its alloys are useful materials for oxygen or liquid oxygen service.
Oxygen will undergo highly exothermic reactions or explosions with many materials. The reactions increase in violence the greater the concentration of O₂ in contact with the fuel or reducing agent. Air has 21% oxygen; above 23 volume % oxygen reactivity with environmental materials is substantially increased.
Oxygen reacts explosively with phosphine, hydrazine, hydrogen sulfide, ethers, alcohols, hydrocarbons, etc., etc. Liquid oxygen mixtures with powdered metals can be detonated. Red hot steel burns in an oxygen atmosphere.

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SECTION VI. HEALTH HAZARD INFORMATION	TLV None Established
<p>Adults can satisfactorily breathe pure oxygen for extended periods at 0.33 atm, or at 1 atm for several days at less than 5 hrs/day. Chest pains and cough can result from breathing O₂ at 1 atm for 8-24 hrs or 2 atm for 2-3 hrs or from an atmosphere of 60% oxygen for several days. A variety of central nervous system effects can occur on breathing oxygen at partial pressures greater than 2 atm, including dizziness, impaired coordination, visual and hearing disturbances, and seizures.</p> <p>Contact with liquid oxygen can produce severe frostbite and freeze burns. Prolonged breathing of very cold atmospheres can produce lung damage. Prolonged exposure to cold areas can result in hypothermia.</p> <p>FIRST AID:</p> <p><u>Contact with liquid oxygen:</u> Remove victim from source of contact. Flush affected areas with lots of tepid water. (Do not apply direct heat to affected area!) Loosely apply dry, sterile, bulky dressings to protect area from infection/injury. Get medical attention.</p> <p><u>Hypothermia:</u> Remove victim to warm (not hot) area. Wrap in blankets. Slowly restore body temperature. Get medical attention.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel of significant leaks or spills. Provide optimum exhaust ventilation. Shut off oxygen source if possible. Remove sources of heat or ignition and, if feasible, separate from combustibles. Small leaks in an oxygen system in enclosed, unventilated area can build-up a hazardous oxygen level.</p> <p>To increase the rate of controlled evaporation of spilled liquid oxygen (when desired) spray with large amounts of water. (Fog may be generated and reduce visibility.)</p> <p>DISPOSAL: Remove waste containers or leaking cylinders to exhaust hood or outdoors away from combustibles and allow to discharge at a moderate rate. Tag cylinder to indicate defect, close valve and return to supplier.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Where oxygen may be released, provide adequate ventilation to prevent excessive oxygen-enrichment of the workplace atmosphere (holding at <23 Vol % O₂ is recommended for fire safety). Personnel who have been exposed to high oxygen concentrations should stay in a well-ventilated or open area for 15 minutes before going into a confined space or near an ignition source.</p> <p>Workers handling liquid oxygen should use safety glasses, clean, approved insulating gloves and other approved protective clothing as required to prevent skin contact. (Gloves and protective clothing must be of material resistant to ignition on contact with liquid oxygen -- leather gloves and safety shoes have been recommended.) Safety shoes and safety glasses are recommended in handling cylinders of compressed gas.</p> <p>If oxygen-enriched clothing catches fire, extinguish under safety shower; fire blanket may not be effective. Use continuous water spray to <u>soak</u> clothing of a rescuer who <u>must</u> operate in an oxygen-enriched fire area.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store oxygen containers in a clean, cool, dry, well-ventilated, low fire-risk area, away from combustible materials. Protect containers against physical damage. Follow general safety procedures for handling compressed gas cylinders. Never expose any part of a cylinder to temp. above 125 F. Ground equipment to eliminate build-up of static charge. Ensure that containers of liquid oxygen are properly vented to prevent pressure build-up and that suitable materials are used to contact liquid oxygen and high purity oxygen. Some materials are unsuitable for service at low temperatures because they become brittle and can be easily shattered by impact. Many materials are unsuitable for oxygen service; do not use oil or grease to lubricate valves on oxygen cylinders.</p>	
DATA SOURCE(S) CODE: 1,2, 4-12, 17,24,25	APPROVALS: MIS, <i>J. M. [Signature]</i> CRD Industrial Hygiene and Safety <i>HTV 5-16-80</i> MEDICAL REVIEW June 1980
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MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1148 CATALYN STREET
SCHENECTADY, NY 12303-1838 USA
(518) 377-8855



NO. 34

OZONE

Revision A

Date February 1982

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: OZONE

DESCRIPTION: Electronic radiation of air provides up to 2% ozone in air for on site laboratory or commercial use. It can be produced in the liquid state, but shipping costs are too expensive. It is present in air at up to about 0.05 ppm at sea level (variable) and is produced when air is exposed to electric discharge or UV radiation.

OTHER DESIGNATIONS: O₃, CAS #010 028 156, Triatomic Oxygen

MANUFACTURER: Usually produced on-site.

SECTION II. INGREDIENTS AND HAZARDS

Ozone gas in air

<2*

HAZARD DATA

8-hr TWA 0.1 ppm**
or 0.2 mg/m³

Human, InhalationICL

*Level of ozone attainable in "ozonized" air. Concentrated liquid can be obtained by cooling this ozonized air to -180 C.

**Current (1981) ACGIH TLV; also proposed OSHA Standard with an Action Level at 50% of the permissible exposure limit.

ppm/time effects

0.2/3-Hr Eye

1 Pulmonary

1.8/75 min CNS

100/1 min Skin

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C --- -112

Density liquid at -183C, g/ml --- 1.57

Vapor density (Air=1) --- 1.65

Freezing point, 1 atm, deg C --- -192

Water solubility at 20 C, by wt - 3 ppm

Molecular weight --- 48.00

Critical temp, deg C --- -12.1

Appearance & Odor: A colorless to blue gas (dependent on concentration) with a pungent characteristic odor which is detectable above 0.01 ppm and becomes disagreeable (sulfur-like) above 1-2 ppm. Olfactory fatigue develops rapidly. (Also, a dark blue liquid or solid)

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method

Autoignition Temp.

Flammability Limits in Air

LOWER

UPPER

N/A

N/A

N/A

Extinguishing media: When this material is involved in fire, use large amounts of water spray.

This material increases the intensity of combustion as compared to the burning or exploding of material in air or with a comparable amount of O₂. Extinguishing procedures depend on the surrounding materials.

Self-contained breathing apparatus with full-face protection should be used by those fighting a fire in which this material is involved.

SECTION V. REACTIVITY DATA

Unstable at ordinary temperatures; spontaneously decomposes to O₂ and, thus is found in highest concentration only near the point of its generation. (It can be stored for prolonged periods as a liquid under cryogenic conditions.)

It is an oxidizing agent for both organic and inorganic materials; it is a stronger oxidizer than O₂, but less strong than fluorine. Some of its reaction products, such as oxonides formed from unsaturated hydrocarbons, can be highly explosive. Solutions containing ozone can explode on warming.

Keep away from heat, flame, strong reducing agents, and combustible materials, such as grease and oil.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 0.1 ppm

Excessive exposure is highly irritating and can be damaging to the eyes, nose, throat, and lungs. Exposure above 0.1 ppm causes drying of the mucous membranes of the mouth, nose and throat. A short exposure at 1-2 ppm produces headache as well as irritation of the respiratory tract, but symptoms subside when exposure stops. High concentrations and/or excessive duration of exposures above the TLV can produce nausea, pain in chest, cough, dyspnea, reduced visual acuity, fatigue, and pulmonary edema. Inhalation of >20 ppm for an hour or more (or 50 ppm for 1/2 hour) could be fatal. Symptoms of edema from excessive exposure can be delayed one or more hours. Acute damage from ozone appears to be mainly from its oxidizing effect on contact with tissue, but it may have chronic effects on the lungs and on lung tumor acceleration.

FIRST AID:

Eye Contact: Get prompt medical help.

Inhalation: Remove to ozone-free air. Get medical help. Keep warm, quiet and at rest and observe for delayed pulmonary edema. Administration of O_2 has been recommended if breathing is labored.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Evacuation of workers should be planned prior to emergency condition. Approved self-contained respiratory equipment with full face protection should be used by those involved in handling leaks and in emergency conditions. Detect leaks by exposing paper impregnated with 4% potassium iodide (dried) to suspected area. Paper turns brown if ozone is present.

Provide ventilation to dilute and disperse small amounts of ozone into the outside atmosphere.

Follow Federal, State and local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements in the workplace. Respirators of approved types must be available where overexposure to ozone is possible in a workplace. All exposures above 1 ppm must use full face protection, and exposures above 5 ppm require an air-supplied or self-contained respirator. Cartridge or gas mask-type respirators with organic vapor-type cartridge(s) or canister are suitable only below 5 ppm ozone.

Where ozone is generated (or where liquid ozone is stored or used) explosion hazard and health hazards will exist and must be guarded against by proper planning, equipment, training, and work practice.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Exclude from industrial exposures to ozone those individuals with a history of heart or lung problems. Also certain individuals may be more susceptible to injury from ozone exposure than others; because of a certain enzyme deficiency they may become ill from exposures which are readily endured by a normal worker.

[see Calabrese, et, al. J. Toxicol, Health 2 (1977) 909]

2,4-9,12,14,16,17,27,31,37,
DATA SOURCE(S) CODE: 38.47 (See also ASTM E591)

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APPROVALS: MIS
CRD

Industrial Hygiene
and Safety

MEDICAL REVIEW: 10 February 1982

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Appendix C
RESPIRATORY PROTECTION PROGRAM

RESPIRATORY PROTECTION PROGRAM

Respirator Administration

The Respiratory Protection Program Coordinator is the Designated Health and Safety Officer (DHSO) for the Denver, Colorado, office (currently Marcus W. Johnshoy). The program became effective on April 1, 1987.

Responsibilities include selection and purchase of respirators, organization of training, and administration of the program to include use, maintenance, storage, and sanitary care.

The project managers/supervisors will supervise the program for their jobs and in their areas of supervision. Project manager/supervisors will also be responsible for issuing respirators and enforcing their use.

Respirator Selection

Respirators will be selected by the DHSO in cooperation with the project manager/supervisor. Only respirators approved by the National Institute for Occupational Safety and Health will be selected for use based upon the nature of the hazard and its concentration.

Typical jobs and types of respirators used at HLA:

<u>Job</u>	<u>Type of Respirator</u>
Soil sampling in potentially pesticide contaminated area	Scott Model #65, full-face, 642-0A-H cartridge
Monitor well installation and sampling in potentially solvent contaminated areas	Scott Model #65, full-face, 642-OA cartridge

Respirators will be purchased from an authorized manufacturer's representative.

Employees will be provided the brand and model of respirator indicated on the employee's fit test record.

Respirator Assignment

Respirators will be individually assigned and marked with a unique identification number.

Respirator Training

Training will be conducted during the employee's Hazardous Materials Health and Safety Training or at time of issue. Training will include respiratory hazards; alternate engineering/administrative controls; respirator types based on hazard, functions, capabilities, and limitations of respirators; donning and fit testing; proper wearing; and maintenance. If necessary, training will be conducted by the DHSO using the following training aids and materials:

- Manufacturer's Instructions
- HLA's Health and Safety Training Manual
- Hands-on training and formal presentations during safety training
- American National Standards Institute's Practices for Respiratory Protection - Z88.2, 1980
- Occupational Safety and Health Administration Standards

Respirator Cleaning/Sanitization

Each employee will be responsible for cleaning their respirator. A sink, detergent, and sanitizer for respiratory cleaning and sanitizing will be available at the decontamination facilities or at HLA's Denver office.

Respirator Inspection and Maintenance

Individually assigned respirators will be inspected on a regular basis by the DHSO. A log of these inspections will be maintained in the respirator record files.

Respirator repairs and maintenance will be performed by the DHSO and/or approved alternate or a factory authorized representative. There will be no replacement of parts or repairs beyond the manufacturer's recommendations.

Respirator Storage

Between use, respirators will be stored in sealable plastic bags where they will be protected from dust, chemicals, sunlight, and extreme heat, cold, or moisture.

Program effectiveness will be evaluated through regular inspections of each area where respirators are used and stored. The DHSO or Site Safety Officer will be responsible for evaluation of program effectiveness.

Self-Contained Breathing Apparatus (SCBA)

All SCBAs will be inspected prior to each use. Only Grade D breathing air will be used to fill air tanks. Any SCBA used for emergency purposes will be inspected monthly to verify that all components are in good working condition and do not need repair. A copy of the monthly inspection checklist is attached.

Respirator Records

Records for the respirator program will be maintained in the Health and Safety office files. The records will include:

1. Approximate numbers and types of respirators in use
2. HLA respirator user approval form
3. Medical evaluation sheet
4. Program surveillance and maintenance reports
5. Respirator inspections logs

SCBA INSPECTION CHECKLIST

Device_____

Serial No. _____

Date Inspected_____

Inspected By_____

Location_____

	TO BE REPLACED	OKAY
FACEPIECE	_____	_____
FACEPIECE LENS	_____	_____
HEAD HARNESS	_____	_____
RUBBER HOSE	_____	_____
"O" RING (Reg.)	_____	_____
INHALATION VALVE	_____	_____
EXHALATION VALVE	_____	_____
HARNESS	_____	_____
BACKPACK	_____	_____
CLEANLINESS	_____	_____
INSTRUCTION SHEET	_____	_____
FOGPROOF	_____	_____
AIR CYLINDER PRESSURE	_____ PSI	_____
CYLINDER VALVE	_____	_____
BYPASS VALVE	_____	_____
MAINLINE VALVE	_____	_____
PAK ALARM	_____	_____
REGULATOR DIAPHRAGM	_____	_____
REGULATOR FUNCTION	_____	_____
PESSURE DEMAND	_____	_____
STORAGE BOX	_____	_____

COMMENTS: _____

Appendix D

O.H. MATERIALS CORPORATION
HEALTH AND SAFETY PLAN

**SITE SPECIFIC HEALTH AND SAFETY PLAN
FOR
ROCKY MOUNTAIN ARSENAL
DENVER, COLORADO**

Prepared For:
Harding Lawson Associates

Prepared By:
O.H. Materials Corporation
A Subsidiary of OHM Corporation
Pittsburgh, Pennsylvania

Richard Bohrer, CIH
Western Region Health and Safety Manager

June 30, 1989
OHM Project No. 7097

TABLE OF CONTENTS

	<u>PAGE</u>
1.0 INTRODUCTION	1-1
1.1 TASK SUMMARY	1-1
1.1.1 Task Order Scope of Work	1-3
1.1.2 Objectives	1-4
1.1.3 Health and Safety Responsibilities	1-4
2.0 SAFETY ORGANIZATION, ADMINISTRATION AND RESPONSIBILITIES	2-1
2.1 RESPONSIBILITIES	2-1
3.0 SITE HISTORY AND OPERATION	3-1
4.0 HAZARD ANALYSIS	4-1
4.1 CHEMICAL HAZARDS	4-1
4.1.1 Ozone	4-1
4.1.2 Hydrazine	4-2
4.1.3 Monomethyl Hydrazine	4-3
4.1.4 Unsymmetrical Dimethylhydrazine	4-3
4.1.5 Nitrosodimethylamine	4-4
4.1.6 Asbestos	4-4
4.1.7 Peroxides	4-6
4.1.8 Ultra Violet Light	4-6
4.1.9 Other	4-7
4.2 CONSTRUCTION/START-UP	4-7
4.2.1 Heavy Equipment	4-7
4.2.1.1 Excavation	4-8
4.2.2 Line Breaking and Confined Space Entry	4-8
4.2.3 Building Construction	4-9
4.2.3.1 Head and Back Injuries	4-10
4.2.3.2 Electrical Hazards	4-10
4.2.3.3 Slipping, Tripping, and Fall Hazards	4-10
4.2.3.4 Hand and Power Tools	4-11
4.2.3.5 Welding and Cutting	4-11
4.2.3.6 Signals and Warning Signs	4-11
4.2.3.7 Mechanical Equipment	4-12
4.2.3.8 Building Erection	4-12
4.2.4 Start-Up Operation	4-12
4.2.5 Modifications	4-13
4.3 ENVIRONMENTAL HAZARDS	4-13
4.3.1 Weather and Heat Stress	4-13
4.3.2 Plague	4-15
4.3.3 Insects and Snakes	4-16
4.4 IMPLEMENTATION PLAN	4-17

TABLE OF CONTENTS (CONTINUED)

	<u>PAGE</u>
4.5 HAZARD AND RISK ANALYSIS	4-17
4.5.1 Mechanical	4-18
4.5.2 Electrical	4-18
4.5.3 Chemical	4-19
4.5.4 Acoustical	4-20
4.5.5 Ultra Violet Light Hazard	4-20
4.5.6 Fire and Explosion	4-20
4.5.7 Slip/Fall Hazard	4-22
4.5.8 Risk Analysis	4-22
5.0 MEDICAL SURVEILLANCE	5-1
5.1 GENERAL	5-1
5.2 SPECIFIC	5-1
6.0 AIR MONITORING	6-1
6.1 AMBIENT AIR - PRE-ACTIVITY	6-1
6.2 CONSTRUCTION/MODIFICATION	6-1
6.3 START-UP	6-2
6.4 IMPLEMENTATION PLAN	6-2
6.5 CALIBRATION	6-3
7.0 SAFETY TRAINING	7-1
7.1 GENERAL	7-1
7.2 JOB SITE TRAINING/FACILITY ORIENTATION	7-1
7.3 DAILY TRAINING	7-2
7.4 PRE-PHASE TRAINING	7-2
8.0 PERSONAL PROTECTIVE EQUIPMENT	8-1
8.1 LEVELS OF PROTECTION/PPE	8-1
8.1.1 General Site and Construction Activities	8-1
8.1.2 Line Breaking	8-2
8.1.3 Start-Up Maintenance and Operation of the Treatment System	8-3
8.1.4 Implementation Plan	8-3
9.0 GENERAL SAFETY	9-1
9.1 DAILY SAFETY MEETINGS	9-1
9.2 PERSONAL HYGIENE	9-1
9.2.1 Eating, Drinking, and Smoking	9-1
9.3 PARKING	9-2
9.4 REVIEW OF HEALTH AND SAFETY PLAN	9-2

TABLE OF CONTENTS (CONTINUED)

	<u>PAGE</u>
9.5 MATERIAL SAFETY DATA SHEETS (MSDS)	9-2
9.6 SITE SAFETY LOGS	9-2
9.7 "BUDDY SYSTEM" VISUAL OR RADIO CONTACT	9-2
10.0 WORK ZONES AND DECONTAMINATION	10-1
10.1 EXCLUSION ZONE	10-1
10.2 CONTAMINATION-REDUCTION ZONE	10-1
10.3 SUPPORT ZONE	10-1
10.4 ACCESS CONTROLS	10-2
10.5 CONSTRUCTION	10-3
10.5.1 Task-Specific Work Zones	10-3
10.5.1.1 Line Entry	10-3
10.5.1.2 Excavation and Building Construction	10-3
10.5.2 Line Entry	10-3
10.5.2.1 Personal Decontamination	10-3
10.5.2.2 Equipment Decontamination	10-5
10.6 START-UP	10-5
10.6.1 Work Zones	10-5
10.6.2 Personnel Decontamination	10-5
10.7 IMPLEMENTATION PLAN	10-6
10.7.1 Work Zones	10-6
10.7.2 Decontamination	10-6
11.0 ACCIDENT INVESTIGATION	11-1
11.1 OHM STANDARD PROCEDURES	11-1
11.1.1 Procedures	11-1
11.2 RMA GUIDELINES	11-3
11.2.1 Accident Investigation and Reporting	11-3
11.2.2 Compliance and Audit Procedures	11-5
12.0 EMERGENCY PROCEDURES	12-1
12.1 EMERGENCY SIGNALS	12-1
12.2 EMERGENCY EVACUATION FROM EXCLUSION AND CONTAMINATION ZONE	12-1
12.3 FIRST AID	12-2
12.4 EMERGENCY ACTIONS	12-3
12.5 GENERAL EVACUATION PLAN	12-3
12.6 EMERGENCY TELEPHONE LOCATION AND CALL PROTOCOL	12-4
12.6.1 Telephone Location	12-4
12.6.2 Emergency Phone Numbers	12-4
12.6.3 Emergency Telephone Call Protocol	12-4
13.0 SUBCONTRACTOR SAFETY TRAINING	13-1

TABLE OF CONTENTS (CONTINUED)

	<u>PAGE</u>
14.0 WASTE DISPOSAL PROCEDURES	14-1
14.1 GENERAL	14-1
14.2 INSPECTIONS	14-1
14.3 MARKINGS	14-1
14.4 HAZARDOUS WASTE CONTAINER LOG (HWCL)	14-2
14.5 CONTAMINATED WASTE DISPOSAL	14-3
14.6 DISPOSAL OF TREATED LIQUIDS BY CHEMICAL OXIDATION PROCESS	14-3
15.0 RECORD KEEPING	15-1
16.0 SITE SECURITY	16-1
17.0 SYSTEM SAFETY HAZARD ANALYSIS REPORT	17-1
17.1 PRELIMINARY HAZARD ANALYSIS	17-1
17.2 SYSTEM HAZARD ANALYSIS	17-2
18.0 REFERENCES	18-1

TABLES

FIGURES

APPENDIX A - MATERIAL SAFETY DATA SHEETS

APPENDIX B - RESPIRATORY PROTECTION PROGRAM

APPENDIX C - OHM SELECTED PROCEDURES

APPENDIX D - WORKER ACKNOWLEDGEMENT TO HEALTH AND SAFETY PLAN

1.0 INTRODUCTION

This Health and Safety Plan has been prepared by O.H. Materials Corporation (OHM) for implementation of all Phase I construction and analytical activities related to the Hydrazine Blending and Storage Facility (HBSF) decommissioning.

1.1 TASK SUMMARY

The HBSF at the Rocky Mountain Arsenal (RMA), near Denver, Colorado, was constructed in 1959 and operated for 23 years from 1959 to 1982. The 10-acre site consists of two tank yards, each completely surrounded by security fencing. The yards are connected by two overhead pipelines. The location of the RMA is depicted on Figure 1-1. The HBSF is located within the RMA as shown on Figure 1-2.

The HBSF was used as a depot to receive, blend, store, and distribute hydrazine fuels. The primary operation was blending of anhydrous hydrazine and unsymmetrical dimethylhydrazine (UDMH) to produce Aerozine 50. The materials were manufactured elsewhere and shipped to RMA for blending. Blending operations were not continuous and occurred in response to requests by the U.S. Air Force. Other operations at the HBSF included loading and unloading rail cars and tank trucks, destruction of off-specification Aerozine 50, and storage of Aerozine 50, anhydrous hydrazine,

monomethyl hydrazine (MMH), monopropellant hydrazine, hydrazine 70, UDMH, and hydrazine.

Hydrazine and UDMH are unstable in the natural environment and rapidly decompose when exposed to the atmosphere. One of the decomposition products of UDMH is n-nitrosodimethylamine (NDMA), a suspected human carcinogen. From January through March 1982, the U.S. Occupational Safety and Health Administration (OSHA) surveyed the HBSF and detected the presence of airborne NDMA within the HBSF. In May 1982, RMA ceased operations and closed the HBSF to all but safety-essential or emergency-response entries.

On February 1, 1988, a proposed Consent Decree was filed in the case of U.S. v. Shell Oil Company with the U.S. District Court in Denver, Colorado. A modified version of the Consent Decree was filed on June 7, 1988. On February 17, 1989, a Federal Facility Agreement (FFA) that incorporates the provisions of the modified Consent Decree was executed by the U.S. Army, Shell Oil Company, the U.S. Environmental Protection Agency (EPA), the U.S. Department of the Interior (DOI), the U.S. Department of Justice (DOJ), and the U.S. Department of Health and Human Services (DHHS). The FFA specifies a number of Interim Response Actions (IRAs) to alleviate certain concerns prior to the final remedial action. IRA H, Closure of the HBSF, is to be implemented at the HBSF. The IRA process described in the FFA requires preparation of an Assessment

Document, a Decision Document to include Applicable or Relevant and Appropriate Requirements (ARARs), and a Draft Implementation Document prior to implementation of the response action. At this time, the Assessment Document and Decision Document have been completed. Harding Lawson Associates (HLA) will develop the Draft Implementation Document. This section presents a summary of the scope of work for the task.

1.1.1 Task Order Scope of Work

The HBSF IRA H Task has been separated into two phases, which comprise the decommissioning of the HBSF at RMA. Phase I includes planning, wastewater treatment system selection and modification, system installation, analytical method development and certification, startup testing, and development of a Draft Implementation Document for facility decommissioning. Phase II will involve planning, installation of a second wastewater treatment system, operational treatment of wastewater, reduction and elimination of the facility hazards, dismantling of all above-ground structures and equipment, disposal of generated solid and liquid waste streams, and preparation of a Technical Report to document facility decommissioning. The present Task Order addresses only Phase I of IRA H.

1.1.2 Objectives

The principal Phase I objectives are to:

- Conduct a bench/pilot-scale testing program to select an appropriate chemical oxidation/ultraviolet (UV) irradiation treatment system for treatment of hydrazine wastewater stored at the HBSF
- Determine necessary treatment system modifications to achieve the desired discharge concentrations for the chemicals of concern in the wastewater
- Develop and certify an analytical method for analysis of NDMA in treated wastewater to achieve a Certified Reporting Limit (CRL) as referenced in the Task Order
- Conduct start-up testing of the selected treatment system at the HBSF
- Gather sufficient process information from the start-up testing to more specifically define operational treatment requirements
- Prepare a Draft Implementation Document defining step-by-step procedures for decommissioning above-ground equipment and treatment of remaining hydrazine wastewater at the HBSF.

1.1.3 Health and Safety Responsibilities

Health and safety responsibilities for the HBSF IRA H Phase I work are split between HLA and OHM depending on the current task activity. Task activities addressed by this Health and Safety Plan (HSP) are comprised primarily of site work and are listed as follows:

<u>TASK ACTIVITY</u>	<u>PRIMARY RESPONSIBILITY</u>
Bench/Pilot Test Wastewater Collection	HLA
Site Facilities Inspections for Design	HLA
Site Improvements/Construction	OHM

<u>TASK ACTIVITY</u>	<u>PRIMARY RESPONSIBILITY</u>
Treatment Plant Installation	OHM
Initial Startup	OHM
Long-Term Startup	HLA
Treatment Plant Modifications	OHM
Wastewater Sampling	HLA
Facility Investigations for Implementation Document Preparation	OHM

Primary responsibilities means the company so indicated will provide the site safety officer. All work done by both HLA and OHM on the respective task activity will be performed under the safety direction of that officer.

The HSP essentially incorporates two plans: one plan prepared by HLA and this plan prepared by OHM. The OHM plan is included as Appendix D to the HLA HSP and is designed to be a stand-alone document. As such, the OHM plan incorporates some identical material contained in the HLA plan. This approach to the plan was taken to provide OHM site personnel with a plan to use specifically for their activities. Because OHM is subcontractor to HLA on the task and HLA is ultimately responsible for all task work including safety of task performance, the OHM HSP is included as part of the HLA HSP.

2.0 SAFETY ORGANIZATION, ADMINISTRATION AND RESPONSIBILITIES

The health and safety coordinator for OHM will be responsible for the monitoring of all health and safety related activities performed by OHM during plant construction, start-up, and modification, and site activities for preparation of the implementation plan.

In addition, OHM will designate a person who will be responsible for modifications to the treatment plant and the safety of anyone assisting in this activity. HLA will designate safety and operations personnel for daily operations within the treatment plant.

2.1 RESPONSIBILITIES

Both HLA and OHM will provide the appropriate safety and management personnel to carry out their respective task activities given in Section 1.1.3. Under OHM, the following health and safety job descriptions will apply at the site.

- Site Supervisor - The site supervisor reports to the project manager and has total control over facility activities. Specific responsibilities include:
 - o Coordinate activities with appropriate officials
 - o Brief individuals on their specific assignments
 - o Utilize the site safety officer to ensure that safety and health requirements are met
 - o Prepare reports and maintain files related to facility operation

- o Oversee the entire operation and monitor effectiveness of contaminant destruction.
- Site Safety Officer - The site safety officer advises the site supervisor on health and safety issues at the facility. The site safety officer recommends stopping work if any operations threatens worker or public health or safety. Specific responsibilities of the site safety officer are:
 - o Selection of protective clothing and equipment
 - o Periodic inspection of protective clothing and equipment
 - o Monitoring of protective clothing and equipment including proper storage and maintenance
 - o Control of entry and exit at the Access Control Points
 - o Monitoring of each worker's suitability for work on the basis of physical abilities and physician's evaluation
 - o Monitoring of the work parties for signs of stress, such as, cold exposure, heat stress, and fatigue
 - o Monitoring of on-site hazards and conditions
 - o Monitoring of periodic inspections to evaluate conformance with the Safety Plan
 - o Enforcing the "buddy" system
 - o Knowledge of and coordination of all emergency procedures, evacuation routes, and the telephone numbers of the ambulance, local hospital, poison control center, fire department, and police department
 - o Notification (when necessary) to the local public emergency officials
 - o Coordination of emergency medical care.

The site supervisor may act as the site safety officer when the need for a full-time site safety officer is considered unnecessary. All such substitutions will have to be approved by the OHM site safety coordinator.

3.0 SITE HISTORY AND OPERATION

The HBSF was owned by the U.S. Air Force and was operated by the U.S. Army from 1962 to 1982 (EBASCO Services, Inc. 1988). The HBSF is located in the northeast corner of Section 1, to the east of South Plants. The site is surrounded by a security fence and is divided into two sections connected by overhead pipelines (Figure 3-1).

The western portion of the HBSF was constructed in 1961. This area was used to load and unload rail cars and tank trucks. An office, blending equipment, and storage facilities are also located in this area. Storage facilities include a 44,000-gallon, in-ground, concrete wastewater tank, a drum storage pad with drum filling equipment, and equipment sheds. The eastern area was built in 1976 to provide additional storage and includes a 50,000-gallon tank and a 200,000-gallon tank. This eastern portion is the study area for this HSP.

In addition to storage, the HBSF has been utilized to receive, blend, and distribute hydrazine fuels. Fuel materials were imported to RMA from other sources for blending on an as-needed basis dictated by the Air Force. The most common operation was production of Aerozine-50, a blend of UDMH and hydrazine. Aerozine-50, UDMH, hydrazine (MMH), monopropellant hydrazine, and

hydrazine-70 were stored at the site. Destruction of off-specification Aerozine-50 also occurred at this site.

The maximum volume of wastewater currently stored on site is estimated to be 300,000 gallons. This wastewater was stored in two vertical, steel tanks and one in-ground, concrete tank. Residues from drum filling and washing operations were also collected and stored in the in-ground concrete tank. A batch treatment with solid calcium hypochlorite was used to oxidize the hydrazine into ammonia, nitrogen, and water. Sludge resulting from this process was disposed of in pits located in Sections 30 and 36 from 1975 through 1978. Treated wastewater was pumped through an industrial sewer to Basin F until 1982. Thereafter, neutralized wastewater was stored on site, except for approximately 10,000 gallons shipped to Lowry Air Force Base.

Records of only two large spills are noted for this facility. In 1975, the fire protection system malfunctioned and filled the pit around the largest UDMH storage tank with several hundred thousand gallons of water. No fuels or wastewaters were spilled. The water in the filling pit from the fire protection system was pumped into adjacent fields. In 1976, the same tank leaked UDMH to a depth of approximately 4 inches into the surrounding pit. The UDMH was pumped into storage, neutralized, and disposed in Basin F.

Prior to shutdown of operations at the facility in May 1982, OSHA detected airborne NDMA on site. In December 1982, the U.S. Army Environmental Hygiene Agency conducted a sampling program at the HBSF. Results from this sampling indicated that ambient air did not contain detectable concentrations of UDMH and hydrazine, and wipe samples from connectors and nozzles indicated low concentrations of UDMH and hydrazine. (Wipe samples were used only to determine contaminant locations, and not to assess the level of contamination.) All work areas showed some detectable NDMA air contamination, at concentrations ranging from no detection to $20 \mu\text{g}/\text{m}^3$.

An additional air monitoring program was conducted by Dames & Moore in 1987. The purpose of this program was: (1) to determine the level of personal protection needed for safe entry into the HBSF, and (2) to determine whether additional cleanup was required at the facility. Results of this sampling indicated that the equipment used to blend and formulate hydrazine and associated storage tanks were contaminated with airborne NDMA concentrations ranging from $0.20 \mu\text{g}/\text{m}^3$ to $28 \mu\text{g}/\text{m}^3$. Ambient air monitoring within the facility did not indicate detectable levels of NDMA.

4.0 HAZARD ANALYSIS

4.1 CHEMICAL HAZARDS

Several chemical hazards have been identified as either inherent to the blending facility or to the treatment process.

Before and during drainage, cleaning, and ultimate removal of vessels, process lines, and all appurtenant equipment, a potential exists for contact of hydrazine, MMH, and UDMH. The primary routes of exposure are by dermal adsorption or inhalation. Ingestion and inhalation of dusts laden with asbestos from insulation on piping and various equipment is another potential hazard. During treatment plant operations, a potential exists for inhalation of ozone and dermal exposure to ultraviolet rays. Dermal contact and inhalation of NDMA, a derivative of UDMH, presents another potential hazard during treatment plant operations.

A description of each chemical likely to be encountered is presented below. Material Safety Data Sheets (MSDS) and other pertinent hazard information for these chemicals are included in Appendix A. This information will be read and understood by all site personnel.

4.1.1 Ozone

Ozone is a form of oxygen that is highly reactive and a severe irritant to the mucous membranes and lungs. Headaches, dizziness,

and coughing may occur. Ozone is a strong oxidizer and has a pungent, sulfur-like odor.

4.1.2 Hydrazine

Anhydrous hydrazine, N_2H_4 , is a clear, colorless, caustic liquid with a characteristic organic amine odor suggestive of ammonia or fish. Hydrazine is very hygroscopic, producing white vapors when exposed to air. When combined with selected oxidizers, it has a strong potential for reduction by ignition.

Hydrazine is toxic by inhalation and skin contact, requiring specific measures for personnel protection. The recognized permissible exposure level (PEL) as regulated by the Occupational Safety and Health Administration is 0.1 ppm. Products of hydrazine combustion are also toxic.

Hydrazine is not shock-sensitive and is fairly stable when stored in tight containers of compatible construction. A number of materials, however, including iron rust, catalyze the decomposition of N_2H_4 , with the release of hydrogen constituting an explosion hazard in a confined space. Hydrazine is subject to explosion when exposed to oxidizers and when heated in a confined space. Because of its high reactivity with many common materials, materials for use with N_2H_4 must be carefully selected.

4.1.3 Monomethyl Hydrazine

Monomethyl Hydrazine (MMH) is a clear, colorless, hygroscopic liquid with an ammonia odor. It is a storable rocket fuel similar to hydrazine, but with a lower freezing point and vapor pressure. It is hypergolic with fuming nitric acids and N_2O_4 as oxidizers.

MMH is toxic upon inhalation and skin contact, requiring specific measures for personnel protection. The PEL is 0.2 ppm. The vapors are flammable, and combustion products are considered toxic. Nitrogen padding is required for storage and transfer, as MMH will react with carbon dioxide and oxygen in the air.

MMH is stable, nonexplosive, and insensitive to impact or friction when stored in gas-tight containers of compatible material. A number of materials catalyze the decomposition of MMH and should be strictly avoided. These include iron rust, copper, lead, zinc, and most of their alloys. Selection of materials used with MMH must be carefully done.

4.1.4 Unsymmetrical Dimethylhydrazine

Unsymmetrical Dimethylhydrazine (UDMH) is a clear, colorless, hygroscopic liquid rocket fuel with a strong, fishy, amine odor. It is hypergolic with fuming nitric acids and N_2O_4 used as oxidizers.

UDMH is toxic. It is very volatile and flammable over a wide range of mixtures with air. UDMH is miscible in all proportions with water, alcohol, anhydrous hydrazine and most petroleum fuels. It is a constituent of the fuels JP-X and Aerozine-50.

UDMH is compatible with and can be handled in contact with common metals and selected elastomers and gasketing materials. Air oxidation may change the color of the liquid to light yellow. Iron rust acts as a decomposition catalyst; explosive azide compounds may be formed with mercury.

The significant danger of this substance is spillage that may lead to accidental vapor inhalation, skin contact, and flammable concentrations. Its vapors are approximately twice as heavy as air.

4.1.5 Nitrosodimethylamine

Nitrosodimethylamine (NDMA) is a persistent decomposition product of UDMH. NDMA is a yellow liquid and is soluble in water, alcohol, and ether. NDMA is a suspected human carcinogen, and all contact with NDMA is to be avoided.

4.1.6 Asbestos

OSHA has promulgated a standard of dealing with asbestos exposures during construction, renovation, demolition, and other similar activities. The standard specifies a permissible exposure

limit (PEL) of 0.2 fibers per cubic centimeter of air (f/cc) and an action level of 0.1 f/cc when averaged over an eight-hour workshift. The standard also specifies procedures for medical surveillance of exposed workers, air monitoring, work practices during handling, worker protection measures, and worker training, among others.

OSHA considers asbestos to be a carcinogen and severe respiratory hazard for exposed workers. Three diseases have definitely been associated with asbestos exposure. The most common of these is called asbestosis, a chronic obstructive lung disease. Asbestosis generally occurs in workers exposed to airborne asbestos over a long period of time, usually at least 15 to 20 years, at fairly high levels. Asbestosis is characterized by a progressive scarring of the walls of the air sacs inside the lungs due to a slow buildup of microscopic asbestos fibers. The scarring causes decreased pulmonary function, leading to a number of secondary complications, and eventually is fatal.

The second disease associated with asbestos exposure is lung cancer of the bronchial tubes (bronchogenic cancer), the main air exchange passageways into the lungs. This type of lung cancer occurs in workers exposed over a long period of time, usually at least 10 to 15 years, but at exposure levels well below those which cause asbestosis. Asbestos workers who smoke are much more likely

to develop this type of cancer than those who do not smoke. Bronchogenic cancer is usually fatal within several years of diagnosis.

The third disease associated with asbestos exposure is a very rare, but always fatal, form of cancer called mesothelioma. The duration and extent of exposure necessary to cause this type of cancer are not well known, but may be less than a year at fairly low levels of exposure. Mesothelioma may develop 40 or more years after the exposure has occurred.

4.1.7 Peroxides

Peroxides are strong oxidizers that may react explosively. They can be irritants to the eyes, skin, and mucous membranes. Skin contact may cause bleaching of skin and hair. Eye contact may cause severe damage.

4.1.8 Ultraviolet Light

Ultraviolet (UV) light is the portion of the electromagnetic spectrum that occupies the region between visible light and x-rays.

The UV spectrum ranges from 4 nanometers (nm) to 400 nm. The region of the UV spectrum between 400 and 300 nm is responsible for pigmentation of the skin following exposure to UV light. Eye contact with UV radiation in the region between 320 and 280 nm may cause inflammation of the cornea.

During the treatment plant operation, UV radiation will be used as a catalyst in the hydrazine decomposition. Workers will be cautioned to stay clear of UV light paths, although no serious danger is anticipated.

4.1.9 Other

The following list of additional chemicals, as shown in Table 4-1 at the end of the text, have been detected on the site. However, the maximum levels detected on Table 4-1 are not believed to cause any adverse effects.

4.2 CONSTRUCTION/START-UP

4.2.1 Heavy Equipment

The use of heavy equipment for debris removal, excavation, and lifting presents the greatest potential for injury to personnel. In order to minimize these hazards, designated routes will be established for mobilization through the RMA facility, and site-specific traffic patterns will be established. All trucks will have spotters for backing procedures.

Only qualified personnel will operate heavy equipment. Those crew members directly involved with spotting for the operator will be the only personnel allowed in the vicinity of the heavy equipment. All others will remain a safe distance away from these operations.

Personnel needing to approach heavy equipment during operation will observe the following protocols:

1. Make eye contact with the operator
2. Signal the operator to cease heavy equipment activity
3. Approach the equipment and inform the operator of intentions.

OHM will follow all of RMA's traffic rules. Vehicles will yield to all bikes and pedestrians.

Further standard operating procedures (SOPs) for vehicle and other equipment operations are addressed in Appendix C.

4.2.1.1. Excavation

Excavation activities will be routinely monitored for organic contaminants with a photoionization detector (PID) to alert for such chemical hazards (See Section 6.0, Air Monitoring). Physical hazards during excavation work are associated with, e.g., physical obstructions, soil conditions, and personnel equipment operating at unclear distances from excavation cut. Preventative hazard measures are presented in Appendix C.

4.2.2 Line Breaking and Confined Space Entry

During any line or tank entry work, personnel will follow personal protective equipment requirements for Level B protection. (See Section 8.0) This is a minimum requirement to reduce chemical

hazards. Potential chemical hazards include spills, leaky valves, unknown contents (i.e., in line or tank), or atmospheric conditions (i.e., tank) that could lead to fire or explosion. Potential physical hazards associated with line and tank entry include, for example, unsafe working platforms and rigging, improper cutting tools, improper lighting (i.e., in tanks, slips, trips, or falls, etc.). Reducing and, at best, preventing such hazards requires proper training and safe work practices.

Standard operating procedures for line entry and confined space entry are addressed in Appendix C. Tank entry procedures are the same as for confined space entry. Appendix A-MSDSs, and Appendix C-SOPs, are complementary in that Appendix A addresses safety guidelines regarding chemical hazards and Appendix C sets precautions for physical hazards.

4.2.3 Foundation Construction and Equipment Installation

Prior to and throughout the treatment plant construction, the workers will be trained to reduce and at best avoid common physical hazards associated with construction. These include but are not limited to: head/back injuries, electrical hazards, slips, trips, and falls, improper use of hand and power tools, welding and cutting, improper signals or warning signs, and improper operation of mechanical equipment.

4.2.3.1 Head and Back Injuries

As minimum requirements, hardhats and safety glasses will be donned prior to performing any site activities. This will prevent minor injuries caused by bumping one's head while working around and under process related structures. Personnel will be reminded to lift with their legs and not their back and to never lift bulky items without assistance.

4.2.3.2 Electrical Hazards

In order to prevent accidents caused by electric shock, the OHM site supervisor will inspect all electrical connections during OHM activity work. He/she will shut down and lock out any equipment found to have frayed or loose connections until a qualified electrician can be contacted. The equipment will be de-energized and tested before any electrical work is done. Only a licensed electrician will perform electrical work. All equipment will be properly grounded prior to and during all work. In addition, Ground Fault Circuit Interrupters (GFCI) will be installed for each circuit between the power source and the tool. In the event that generators are used to supply power, these generators will contain GFCIs.

4.2.3.3 Slipping, Tripping, and Fall Hazards

OHM personnel and subcontractors will be reminded daily to maintain sure footing on all surfaces. Safety belts will be

required by any personnel working three feet above any surface, including OSHA approved man lifts.

In order to minimize tripping hazards caused by dismantlement debris, material will be removed daily from the work areas and stockpiled in their respective storage areas. This "house-cleaning" effort will be enforced by the site safety officer before the end of each work day.

4.2.3.4 Hand and Power Tools

All hand tools will be in good repair and used only for the purpose for which they were designed. Power tools will be inspected, tested, and determined to be in safe operating condition prior to use. Only nonsparking tools shall be used in locations where sources of ignition may cause a fire or explosion.

4.2.3.5 Welding and Cutting

All welding and cutting equipment and operations shall be in accordance with standards and recommending practices of the American Welding Society, Safety in Welding and Cutting, ANSI Z49.1, and the National Fire Protection Association. An OHM hot work permit will be obtained daily or as needed.

4.2.3.6 Signals and Warning Signs

A signal person shall be provided when the point of operation is not in full view of the vehicle or equipment operator during

construction. Warning signs, in the form of Danger or Cautions signs, will be provided where an immediate hazard exists. In addition, any signs to be seen at night shall be lighted.

Once constructed, the treatment plant will have at least one fire exit, and a fire protection equipment location will be identified.

4.2.3.7 Mechanical Equipment

Before any machinery or mechanized equipment is placed in use, it shall be inspected and tested by a competent mechanic. The site supervisor shall designate a qualified person to be responsible for the inspection of all machinery and equipment. All such equipment will be operated only by properly trained designated personnel.

4.2.3.8 Building Erection

For treatment plant erection, safe building practices will be followed in accordance with the Uniform Building Code, General Construction Industry Standards and Subcontractor Construction Specifications.

4.2.4 Initial Start-Up Operations

At the time of treatment plant initial start-up, both ambient and personal air monitoring will be conducted, and periodic spot checks with real-time instrumentation will be conducted under the direction of the site safety officer and the site supervisor. Air

monitoring will be implemented for chemical(s) inherent in the treatment process (i.e., ozone) and in the process lines (i.e., hydrazine). The treatment plant will be maintained according to the subcontractor maintenance plan.

4.2.5 Modifications

Any modifications to the treatment plant operation will be designed under the direction of HLA. Installation and maintenance of modifications will follow specifications approved by HLA. The modified system will be monitored by a process engineer and directed by the site supervisor. In addition, air monitoring will be continuous during installation of the modifications and start-up operation of the modified system.

4.3 ENVIRONMENTAL HAZARDS

Environmental hazards to be considered during site specific work include heat stress, plague, and rattlesnakes.

4.3.1 Weather and Heat Stress

With the possible combination of warm ambient temperature and protective clothing, the potential for heat stress is a concern.

The potential exists for:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke.

An action level for heat stress has been established. At 75 degrees Fahrenheit ambient temperature, the site supervisor will become keenly aware of the effects of heat stress on the field crew, and will alert the crew to become aware of any symptoms. The site supervisor will also advise the crew to increase the amount of salt used on foods.

Heat stroke, heat cramps, and heat exhaustion are covered in detail during OHM's 40-hour OSHA 20 CFR 1910.120 approved preemployment course. In addition, this information is discussed during a safety "tailgate" meeting before each workday. Workers are encouraged to increase consumption of water and electrolyte-containing beverages such as Gatorade during warm weather. Water and electrolyte-containing beverages will be provided on site and will be available for consumption during work breaks.

At a minimum, workers will break every two hours for 10- to 15-minute rest periods. In addition, workers are encouraged to take rests whenever they feel any adverse effects, especially those effects that may be heat-related. The frequency of breaks may need to be increased upon worker recommendation to the site safety officer and site supervisor.

During safety "tailgate" meetings, the site safety officer will talk about heat stress, its symptoms, and the factors that affect a person's ability to handle heat stress.

4.3.2 Plague

Plague is a possible worker health hazard at the RMA project site. The most recent case was announced in May 1989 and involved sylvatic plague-stricken prairie dogs. In order to reduce, and at best, prevent plague transmittal to humans, all workers are cautioned to read the following facts:

- Almost all human cases of plague result from contact with native wild rodents or their fleas
- The bacteria that cause plague are transmitted to people by the bites of infective fleas or direct contact with infected animals
- In humans, the incubation period for plague is usually two to seven days
- The disease is characterized by sudden high fever, chills, headache, prostration, and extreme pain and swelling in a lymph node area
- Antibiotic treatment of early cases usually is effective in curing the disease
- Insecticide dusts to kill fleas on susceptible rodents are often effective in controlling plague
- Site personnel are prohibited from capturing chipmunks, red squirrels, prairie dogs or other rodents for "pets", and dogs and cats should not be allowed to come in contact with rodents.

The site safety officer is responsible for tracking the Department of the Army control procedures for controlling the

plague throughout project work and for presenting periodic status reports. In addition, the following important points will be posted on site:

- If reasonable precautions are taken, the probability of being exposed to and contracting plague is extremely low.
- Plague is treatable and curable if it is diagnosed early; complete recovery can be expected in a majority of such cases. However, it is still a serious disease if not recognized. If you become sick, be sure to inform the doctor that you have been in a locality where plague may have been present.
- Surveillance activities are being conducted in Colorado by trained health department personnel. Please report unusual rodent die-offs to your local or state health departments. Do not attempt to collect rodents for specimens without specific instructions.
- Control efforts are directed at breaking the infection cycle of plague by eliminating flea carriers. These activities are concentrated in areas close to human habitation and in heavily-used recreation sites. So far, this program appears to be effective and there has been little or no impact upon the environment.

4.3.3 Insects and Snakes

Protection against hazards involving insects or snakes will include the following controls:

- Personal protective garments (i.e. boots, gloves, hoods, netting)
- Approved first aid remedies
- Instruction in recognition
- Repellents
- Drainage or spraying of breeding areas
- Burning or destruction of nests

- Elimination of unsanitary conditions which foster insects or vermin
- Extermination measures
- Inoculation.

4.4 IMPLEMENTATION PLAN

In order to control the physical and chemical hazards discussed above, proper training in the standard operating procedures for the specific work tasks and review of the MSDSs is required. The training will be provided by the site safety officer or other designated official. In addition, all workers will have completed all required OSHA training prior to any commencement of work. Section 7.0 discusses the OHM subcontractor training program.

4.5 HAZARD AND RISK ANALYSIS

Many potential hazards exist or will exist at the HBSF and the treatment plant. This section will discuss those hazards, evaluate the potential and probability for the hazard to occur, the consequence of the hazard and safety precautions to be taken to mitigate these hazards. The potential hazards identified for this site are:

- Mechanical
- Electrical
- Environmental hazard
- Chemical
- Acoustical
- Radiological
- Fire and Explosion
- Slip/Fall Hazard.

4.5.1 Mechanical

When working around mechanical equipment, care should be taken. Hazardous conditions that can occur around mechanical equipment can be prevented by adhering to the following precautions:

- Stand clear of mechanical equipment and lock out electrical equipment before performing maintenance. Always remember that some equipment can start or stop without warning.
- If moving part covers are to be removed for maintenance, the equipment must be stopped before removal. Start-up should not occur before the cover is replaced.
- Avoid wearing loose clothing, and tie back long hair.
- Avoid contact with motors as they may be extremely hot.
- Operation devices should be protected from unintended operation.

4.5.2 Electrical

The most important safety practice to remember is to lock out the power supply to equipment when maintenance or repair is conducted. The main circuit breaker should be shut off first, and then each person should place his/her own lock on the breaker. This will avoid possible electrocution should an employee turn on the electricity while another is still working on the equipment.

The following are general guidelines to be followed while working with electrical equipment:

- Inspect and test equipment prior to use

- Be familiar with the 1988 Edition of National Electrical Code
- CPR training is suggested
- Always work with a "buddy"
- Repair frayed or exposed wiring prior to use
- Do not use metal ladders
- Portable electrical equipment should be doubly insulated or grounded
- Extension cords should be three-wire grounded
- No adapters will be used
- Only authorized personnel are permitted to work on high voltage equipment.

Use of extension cords should be avoided if possible. If there is no other option, the following guidelines should be adhered to:

- Extension cords are to be used only in an emergency and are only for temporary use
- All extension cords must be heavy duty service type
- Do not run extension cords through any openings
- Do not staple or nail extension cords in place.

4.5.3 Chemical

Care should always be exercised when working in and around the treatment plant. Air monitoring will be conducted and PPE should be donned dependent on ambient air readings. PPE should also be used when handling chemical compounds or wastewater. Precautions to be followed are:

- Be familiar with the chemical hazard information available in Appendix A of this document.
- Wear appropriate PPE when necessary.
- All leaks and spills are to be reported and cleaned up immediately upon discovery.
- Be familiar with locations and operation of first aid and emergency equipment. This equipment should be checked for proper operation on a weekly basis.

4.5.4 Acoustical

Ear protection will be worn at any time a normal conversation cannot be conducted at a distance of three feet from source of noise.

4.5.5 Ultraviolet Light Hazard

There is a potential for radiation exposure from the UV lights used in the treatment plant. Each employee will be advised to stay clear of direct light paths; however, these light paths should not interfere with daily worker operations and do not pose a serious hazard.

4.5.6 Fire and Explosion

The compounds found in the wastewater have a high probability of explosion and flammability, although mixed with water, this is only somewhat diminished. The compounds used during the treatment process (hydrogen peroxide and ozone) will be in less dilute forms and will be of much greater risk.

The following guidelines are to be followed to minimize the risk of fire and/or explosion:

- Ventilation should be on a 24-hour basis to prevent buildup of explosive gases.
- Be familiar with locations and operation of portable fire extinguishers. All extinguisher locations will be clearly marked and access to these locations shall not be blocked in any manner. Extinguishers will be checked for charge on a weekly basis. Fire extinguishers shall be of the appropriate type for the fire hazards existing at the site.
- No smoking will be permitted inside the plant or the storage tank area.
- Do not allow rubbish and trash to accumulate.
- Minimize dust accumulation as it may pose an explosive risk.
- Oily rags should be placed in airtight containers and/or submerged in a container of water.

Flammable liquids have a low flash point and are a primary source of fire and/or explosive risk. These liquids should be treated with particular care. The following are guidelines for proper handling of flammable liquids:

- Be aware of the hazard properties of these liquids. Adhere to manufacturers' guidelines for storage and handling.
- Keep flammable liquids only in proper containers.
- Provide adequate ventilation at all times.
- Do not mix flammable liquids.
- No smoking! Keep liquids away from potential sources of ignition.

- When transferring flammable liquids from one container to another attach ground wires to the containers.
- Allow for expansion when filling containers.
- Storage containers should be properly grounded and bonded.
- Storage rooms should meet required fire resistance ratings.

4.5.7 Slip/Fall Hazard

When floors are wet, care will be taken to avoid slipping or falling. Spills will be cleaned up immediately to minimize the hazard and rubber soled boots should be worn rather than leather soled. While moving around the plant area, care will also be taken to avoid tripping and resultant possible injury.

4.5.8 Risk Analysis

Table 4-2 presents the risk analysis for this particular task. See back of text for Table 4-2. All the hazards discussed in Sections 4.5.1 through 4.5.7 are listed as well as the potential for exposure, probability that the exposure will occur and the consequence of that exposure.

5.0 MEDICAL SURVEILLANCE

The OHM Medical Surveillance Program is established such that the health of employees is not compromised by potential exposure to chemical or physical agents found at work site.

5.1 GENERAL

All OHM personnel participate in a stringent medical monitoring program as directed in 29 CFR 29 1910.120 Hazardous Waste Operations and Emergency Response. The physical, repeated annually, qualifies OHM personnel to work around potentially hazardous substances and safely wear respiratory protection.

5.2 SPECIFIC

No specific biological monitoring will be required during this project.

6.0 AIR MONITORING

6.1 AMBIENT AIR - PRE-ACTIVITY

Prior to any on-site work the ambient air will be sampled for the presence of hydrazines and NDMA. This will confirm that Level "D" is appropriate for construction activities outside the fenced area. Hydrazines will be measured at the edges of the fenced areas with an HNU photoionization detector (PID) equipped with a strip-chart recorder or an MDA TLD-1 toxic gas detector equipped for hydrazine. NDMA will be measured by collecting samples on a Thermosorb-N cartridge followed by analysis by GC-TEA method. If no hydrazine or NDMA is detected following two days of samples, the area will be considered safe for Level "D" construction work.

6.2 CONSTRUCTION/MODIFICATION

During construction and/or modification procedures, area samples for hydrazines will be taken using the PID or the TLD-1 detector equipped with a strip-chart recorder. Direct reading instruments (PID or Draeger Tubes) will be used to spot check certain activities, such as when fresh soil surfaces are uncovered. Personal samples will be collected for a representative number of employees using Thermosorb-N cartridges for NDMA and Thermosorb-A cartridges for hydrazines. Construction activities involving line breaking will be conducted in Level "B" protective gear and will be monitored more extensively. If any hydrazines are detected by

the direct reading instruments, the area will be cleaned, and work will be resumed only in Level "B". Upgrading to Level "A" protection is not foreseen but such protection will be implemented if necessary.

6.3 INITIAL START-UP

In addition to any present monitors or alarms, air monitoring will be conducted during treatment plant initial start-up to verify that no exposure is occurring. Area samples for hydrazines (PID or TLD-1) and NDMA (Thermosorb-N cartridges) will be employed. The PID can also be used as a "sniffer" for possible leak detection. The TLD-1 system can also be used to detect ozone. A TLD-1 unit will be placed near the ozone generator to detect any leaks. Personal samples for hydrazines (Thermosorb-A) and NDMA (Thermosorb-N) will also be collected during initial start-up operations. If any hydrazines or ozones are detected the area will be cleared and work resumed in Level "B" protective gear.

6.4 IMPLEMENTATION PLAN

During entrance to the fenced areas for purposes of preparing the implementation plan, a PID will be hand-held and used to detect hydrazines. Samples will be collected to determine NDMA exposure (Thermosorb-N). NDMA has been detected inside the tanks in the blending facility; therefore all work in the fenced area will be in Level "B". Additionally, some exposed material that is possibly

asbestos exists. Ambient air and bulk samples for asbestos may be taken for confirmation.

6.5 CALIBRATION

Permeation tubes for hydrazines will be used to calibrate the PID and TLD-1 systems. Sampling pumps will be calibrated with a rotameter daily.

7.0 SAFETY TRAINING

An employee educated to the hazards of the work place is a safer worker. For this reason, OHM conducts a rigorous ongoing training program for its employees.

7.1 GENERAL

Prior to assignment at the site, all OHM employees will have received a 40-hour training session or qualify by experience prior to any site work as required by 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response and SARA Regulations. OHM employees who will don level "B" protection will have additional 24-hour, on-site training required by 29 CFR 1910.120. Subcontractor personnel, other than OHM who work in level "D" protection, will not be required to have had this training.

7.2 JOB SITE TRAINING/FACILITY ORIENTATION

Before commencing this project, a training and review session will be held to cover project-related topics. For this particular project, topics will include:

- Site history and nature of the problem
- Chemicals of concern
- Possible physical hazards
- Work zones--locations of exclusion, contamination reduction, and support zones
- Levels of protection--B and D

- Decontamination procedures
- Emergency procedures and signals.

The pre-construction safety training will be completed after all workers have read and signed the site specific safety plan.

7.3 DAILY TRAINING

Each morning before work begins, a short 10- to 20-minute training session will be held covering one of the previously mentioned topics along with daily instructions.

7.4 PRE-PHASE TRAINING

Before beginning a new phase of work or work in a management area of which the crews are not familiar, a training session will be held covering the chemical and physical hazards related to this particular phase/area.

8.0 PERSONAL PROTECTIVE EQUIPMENT

Work involved within the fenced-in areas at the site will require Level "B" protection (self contained breathing apparatus). This is the highest level of protection anticipated for site work.

8.1 LEVELS OF PROTECTION/PPE

Varying types of protective garments will be worn depending upon the material to be worked with and degree of hazard. The basic level of PPE is defined for each project phase while recognizing that the site supervisor may modify the requirements depending on specific site conditions, equipment configuration, air monitoring results, and previous experience.

8.1.1 General Site and Construction Activities

General site work outside of fenced areas will require Level "D" protective equipment. However, Level "B" will be available if needed. Level "D" equipment includes:

- Steel-toed work boots
- Tyvek or Kleenguard protective coveralls
(primarily to prevent undue soiling of work clothes)
- Hard hat
- Work clothes
- Cotton, leather, or chemical resistant gloves (i.e., Neoprene or Nitrile)

- Eye protection
- Hearing protection (if necessary)
- Faceshield (if necessary).

Level "C" protection may be worn when a lesser degree of respiratory protection (i.e., below Level B) is needed. Level "C" equipment for the site work includes:

- Full-face or half-mask air purifying respirators with cartridges approved for the type of exposures likely to be encountered.
- Hooded, chemical resistant clothing such as overalls, and long-sleeved jacket, one or two piece splash suit or disposable, chemical resistant coveralls
- Gloves - Outer (i.e., Neoprene or Nitrile) and inner (i.e., latex or PVC)
- Boots - Chemical resistant, steel toe, and shank
- Hard hat
- Two-way radio.

8.1.2 Line Breaking

Line breaking will require Level "B" protection. Level "B" protection must be used when the highest level of respiratory protection is required (as in Level "A"), but a lesser degree of skin protection is required. Level "B" equipment includes:

- Pressure - demand (positive pressure) full-face SCBA or airline respirator with escape SCBA.
- Hooded, chemical resistant clothing, such as one or two piece splash suit or disposable chemical resistant coveralls.

- Gloves - Outer (i.e., Neoprene or Nitrile) and inner (i.e., latex or PVC)
- Boots - Chemical resistant, steel toe, and shank
- Hard hat
- Two-way radio.

8.1.3 Start-Up Maintenance and Operation of the Treatment System

Maintenance and operation of the treatment system will generally require Level "D" protection selected to prevent a splash hazard. HLA will be responsible for personal protective clothing and safety of workers during these activities.

If at any time untreated wastewater is to be handled, Level "B" protection as previously described, will be introduced into the operational activity.

8.1.4 Implementation Plan

Implementation of project work inside of fenced-in areas will require Level "B" protection unless air monitoring results show otherwise. Outside of the fenced areas, workers will wear Level "D" protection unless air monitoring results show otherwise. Upgrading or downgrading in levels of protection will not occur until approved by the site safety officer and site supervisor.

9.0 GENERAL SAFETY

The site supervisor is the primary safety official at this site. The site safety officer has the power and authority to suspend any site activity he/she deems to be inherently dangerous to safety or health. In the site safety officer's temporary absence, the general foreman becomes the primary safety official.

9.1 DAILY SAFETY MEETINGS

A safety meeting will be held daily before work commences. The scope of work for the day, hazards of the work, hazards of the materials, use of respirators, decontamination, and hazardous areas of the site will be discussed. Periodically, general subjects such as electrical safety, defensive driving, and heat/cold stress will be discussed.

9.2 PERSONAL HYGIENE

Clean hands are an essential element to good personal hygiene since hands are a primary contaminant contact source of the worker and between workers. Hands must be thoroughly washed upon leaving a contaminated or suspected contaminated area before eating, drinking, or smoking.

9.2.1 Eating, Drinking, and Smoking

Eating, drinking, and smoking shall be permitted only in designated posted areas. In general, smoking will be permitted only in the subcontractor office trailers and/or lunch room.

9.3 PARKING

Parking will be permitted only in designated areas.

9.4 REVIEW OF HEALTH AND SAFETY PLAN

All persons (workers and visitors) entering this site will read the health-and-safety plan. Upon reading, the person must sign the form found in Appendix D which states workers have read and understand the plan and will comply with the conditions of this plan.

9.5 MATERIAL SAFETY DATA SHEETS (MSDS)

MSDSs are included in Appendix A. The site supervisor will keep a file of MSDSs on other chemicals brought to the project for use.

9.6 SITE SAFETY LOGS

A log book recording all first aid administered, regardless of how minor, will be kept by the site safety officer. In addition, a log of weekly inspections of all site safety equipment such as fire extinguishers, first aid kits, and emergency oxygen units will be kept by the site safety officer.

9.7 "BUDDY SYSTEM" AND VISUAL OR RADIO CONTACT

Personnel must use the "buddy" system whenever wearing respiratory protection. Communications between workers must be maintained at all times, either by established visual signals or by radio communications.

10.0 WORK ZONES AND DECONTAMINATION

To prevent migration of contamination caused through tracking by personnel or equipment, work areas and personal protective equipment are clearly specified prior to beginning operations. OHM has designated work areas or zones as suggested by NIOSH/OSHA/USCG/EPA's document titled, "Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities". Each work area will be divided into three zones: an exclusion or "hot" zone, a contamination reduction zone (CRZ), and a support zone.

10.1 EXCLUSION ZONE

The exclusion zone will consist of areas where inhalation, oral contact, or dermal contact with contaminants will be possible.

10.2 CONTAMINATION-REDUCTION ZONE

The CRZ or transition zone will be established between the exclusion zone and support zone. In this area, personnel will begin the sequential decontamination process required to exit the exclusion zone. To prevent off-site migration of contamination and for personnel accountability, all personnel will enter and exit the exclusion zone through the CRZ.

10.3 SUPPORT ZONE

The support zone will consist of a clearly marked area where the office and decontamination trailer are located. Smoking and

drinking will be allowed only in designated areas. Eating will be allowed in the break room only.

10.4 ACCESS CONTROLS

The site safety officer and the site supervisor shall establish the physical boundaries of each zone, consistent with the HLA plan, and shall instruct all workers and visitors on the limits of the restricted areas. No one shall be allowed to enter the restricted areas without the required protective equipment for that area. The site supervisor shall enforce compliance with all restricted area entry and exit procedures.

The site supervisor shall also designate a decontamination point for personnel to exit from the contaminated area and enter into the clean area where personnel may rest and drink.

Visitors should check in immediately upon arrival. Only authorized visitors will be allowed access to the contaminated areas. Each visitor will be required to provide the necessary protective equipment for use during the visits and shall be escorted by the site supervisor while on site. All visitors, subcontractors and personnel will be required to sign a safety plan acknowledgement sheet to certify that they have read and will comply with this site health and safety plan. Failure to comply with this site entry procedure will result in expulsion from the site.

10.5 CONSTRUCTION

During construction activities the work zones and decontamination procedures are defined below.

10.5.1 Task-Specific Work Zones

10.5.1.1 Line Entry

Line entry work is dedicated an as exclusion zone area. The limits of the exclusion zone will be set within a clear distance of all lines determined by air monitoring results. In general, all work to be carried out within the double-fenced east and west tank yards will be part of the exclusion zone until air monitoring indicates that this exclusion zone may be changed.

10.5.1.2 Excavation and Building Construction

All excavation and treatment plant construction activities will commence within an exclusion zone designated area, which will be delineated based on air monitoring results. The limits of the delineated area may change throughout these activities and will be reset by the site safety officer and site supervisor.

10.5.2 Decontamination

10.5.2.1 Personal Decontamination

Personnel decontamination will occur, as a minimum, two times a day (i.e. at lunch and end of the work day). Decontamination of personnel shall be accomplished to satisfy that any material, which personnel may have contacted in the hot zone, is removed in the

contamination-reduction zone. Decontamination of personnel exiting the exclusion zone will be as follows:

Step 1: Scrub the outer boots with a detergent-water solution. Remove and stack boots for drying.

Step 2: Scrub and remove outer gloves.

Step 3: Remove the hard hat and wipe clean.

Step 4: Remove and discard vinyl booties into 55-gallon trash drum.

Step 5: Remove and discard tyvek suit and hood into 55-gallon drum and then clean, disinfect, rinse and air dry the respirator.

Step 6: Remove respirators and suitably store while on breaks and during lunch. At the end of shift, discard the cartridges into a 55-gallon drum and then clean, disinfect, rinse and air dry the respirator.

Step 7: Discard sample gloves into 55-gallon trash drum.

Step 8: Depart transition zone in work clothes and boots.

Step 9: Wash hands, face and neck before breaks and lunch.

Showers will be available to all personnel on site. Showering before leaving the work site will be required for all personnel who have entered the exclusion zone during active work.

Any employee suspected of sustaining contact with chemical materials will first use the emergency shower. Following a thorough drenching, the worker will proceed to the decontamination facility. Here the worker will remove clothing, shower, don clean clothes, and immediately be taken to the First Aid Station. All

liquids and disposable clothing will be treated as contaminated waste and disposed of properly. Personnel handling contaminated waste will wear Level "C" protection.

10.5.2.2 Equipment Decontamination

All equipment will be decontaminated upon leaving the site. All heavy equipment will be steam treated. All smaller equipment including hand tools and smaller machinery will be cleaned with soap and water.

10.6 INITIAL START-UP

During initial start-up activities, the work zones and decontamination procedures will be set forth as follows.

10.6.1 Work Zones

At initial start-up of treatment plant operations, personnel within the plant will wear Level "D" protection. However, Level "B" protection will be available if needed, and suspected "hot" areas will be designated with barrier tape. Outside of the treatment plant, fenced-in areas will remain designated by barrier tape as part of the exclusion zone.

10.6.2 Personnel Decontamination

All OHM personnel will follow OHM standard decontamination procedures for removing Level "B" protective gear, as appropriate. Otherwise, personnel in Level "D" protective gear will be

responsible for their own personal hygiene once they leave the project site.

10.7 IMPLEMENTATION PLAN

This implementation plan involves identifying potential safety and health hazards during Phase II work (i.e., dismantlement of HBSF, operation of treatment plant). To accomplish this in Phase I, a walk-through inspection of the facility in Level "B" protective gear is required. The work for this plan will not consist of any dismantlement but will require an extensive evaluation of the two sites (i.e., storage and blending facilities) to develop this plan.

10.7.1 Work Zones

Work will be accomplished in Level "B" protective equipment, unless directed otherwise. This means that all areas where dismantlement activity takes place will be designated by barrier tape as exclusion zone areas. Suspected asbestos areas will be labeled with asbestos warning signs.

10.7.2 Decontamination

OHM personnel will follow OHM standard decontamination procedures for removal of Level "B" protective gear. These procedures are the same as previously described in Section 10.5.2.1.

11.0 ACCIDENT INVESTIGATION

All injuries and accidents will be reported promptly to the site supervisor and will be documented.

11.1 OHM STANDARD PROCEDURE

All OHM subcontractor personnel will follow OHM protocols for accident and injury investigation and other work-related illnesses as listed below.

11.1.1 Procedures

Reportable incidents include, but are not limited to:

- Injuries to personnel of any magnitude
- Tool or equipment failure which results or could result in serious injury
- Fire or explosion of any magnitude
- Vehicle accidents
- Any damage to client or private property.

All injuries/illnesses, no matter how minor they appear, are to be reported to the employee's immediate supervisor. The supervisor should then see to it that the incident is logged and properly reported.

Under no circumstances should an injured employee drive himself/ herself to the hospital, clinic, etc. An employee with minor injury may be transported by car after first aid treatment

is given. The employee who transports the injured person should be trained in first aid and CPR whenever possible. Any injury that is not minor, or when in doubt of severity of injury, should be transported by ambulance.

Injured employees who require medical treatment or who require treatment by a doctor, hospital, or clinic should not be allowed to resume work without a written return-to-work certification and any limiting work statement from the treating physician. This statement should give diagnosis, date of return to work, and any work limitations. Should a statement such as "light duty" be given, call the treating physician to determine the exact restriction that is needed. Be sure the treating physician understands the type of work the employee normally performs and that alternate work is available to meet work restrictions.

OHM's Division Manager, the Regional Health and Safety Manager, and the Corporate Health and Safety Department are to be notified immediately of any lost time accident. Notice is to be made by telephone.

11.2 RMA GUIDELINES

11.2.1 Accident Investigation and Reporting

All accidents that affect the health or safety of HLA/OHM personnel and/or subcontractors will be investigated, and corrective actions will be taken to prevent similar accidents. Investigations will be conducted for all accidents that result in, but are not limited to: fatalities, disability, property damage, fire, explosion, lost work time, treatment at a medical facility, examination by a medical doctor, nurse, or paramedic, or unexpected exposure to chemical agents or hazardous materials.

The accident/incident investigation report, to be completed by the Health and Safety Coordinator or an assigned person, will include, at a minimum, the following information:

- Contractor and telephone number
- Name and title of the person reporting
- Date and time of the accident or incident
- Location (e.g., Army installation, facility name, building number)
- A brief summary giving pertinent details, including type and quantity of material and type of operation
- Cause, if known
- Casualties (fatalities, disabling injuries, exposure to chemical or biological agents or radiation)
- Details of any known chemical hazard or other hazardous material or contamination
- Estimation of property damage, if applicable

- Nature of the damage; effect on production, operations, training or other activities
- Actions taken to provide safety and security
- Other damage or injuries sustained (public or private)
- Whether or not a release was made to news media; if so, a copy of the published article of statement will be attached
- Any indication of sabotage or espionage, including possible theft or loss of chemical agent or agent-filled munitions
- Any other pertinent information, including causal factors, if they are known, and any possible political implications
- Type of carrier, if one was involved
- Whether assistance was required; if so, the nature of such assistance will be indicated.

If a malfunction of equipment is involved, the Accident or Incident Report will contain the following information in addition to that listed above:

- Equipment nomenclature
- Quantity involved
- Production lot number(s)
- Availability of replacement equipment and time estimate to continue activity.

This report, which will fulfill Army Data Requirement A012, will be submitted to the HLA Health and Safety Manager. An accident investigation form will also be submitted to HLA's corporate industrial hygiene and safety officer.

If an accident occurs, it will immediately be reported to the site safety officer who will in turn notify the task manager and the respective health and safety coordinator for the task work. If the OHM safety personnel are notified of an accident, OHM will then notify the HLA Health and Safety Manager. Accident reports will be conducted as discussed above through an on-site investigation. The scene of the accident will be examined and witnesses will be interviewed. Accidents of a nonserious nature (not resulting in or not likely to result in serious bodily harm or death) will be acted upon within five working days. Responses to accidents of a serious nature (serious injury or death, chemical releases, fire) will be immediate and will include notification of affected parties.

11.2.2 Compliance and Audit Procedures

Audits may be either announced or unannounced on-site inspection of work practices, equipment, records, and personnel knowledge of health and safety issues identified in the Health and Safety Plan. Formal audits will be conducted at least quarterly by the health and safety coordinator. Infractions or violations of established health and safety procedures will be corrected immediately and disciplinary action will be enforced where appropriate. Audit reports will be available for inspection. The site safety officer will be responsible for monitoring the health and safety on a daily basis. The health and safety coordinator will be immediately notified regarding problems and questions.

HLA corporate industrial hygiene and safety staff will periodically conduct unannounced health and safety audits to check compliance. Frequency of the audits will be dependent on work activities and level of risk.

12.0 EMERGENCY RESPONSE

Prior to field activities, the site supervisor shall plan emergency egress routes and discuss them with all personnel who will be conducting the field work. Initial planning includes establishing emergency warning signals and evacuation routes in case of an emergency.

12.1 EMERGENCY SIGNALS

A tested system shall exist for rapid and clear distress communication. All personnel shall be provided concise and clear directions and accessible transportation to local emergency services. Figure 12.1 contains a map outlining directions and telephone numbers to the nearest hospital and will be posted on site.

The following emergency equipment shall be present on the site:

- Fire extinguishers
- Industrial first aid kit
- Eye wash bottles
- Emergency shower.

12.2 EMERGENCY EVACUATION FROM EXCLUSION AND CONTAMINATION-REDUCTION ZONE

Any personnel requiring emergency medical attention shall be evacuated immediately from the exclusion and contamination-reduction zones. Personnel shall not enter the area to attempt a rescue if their own lives would be threatened. The decision

whether or not to decontaminate a victim prior to evacuation is based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination may be an essential part of life saving first aid. For other, decontamination may aggravate the injury or delay life saving treatment. If decontamination does not interfere with essential treatment, it should be performed.

If decontamination can be performed:

- Wash external clothing and cut it away.

If decontamination cannot be performed:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel
- Alert emergency and off-site medical personnel to potential contamination; instruct them about specific decontamination procedures
- Send along site personnel familiar with the incident.

12.3 FIRST AID

Only qualified personnel shall give first aid and stabilize an individual needing assistance. Life support techniques such as CPR and treatment of life threatening problems such as airway obstruction and shock will be given top priority. Professional medical assistance shall be obtained at the earliest possible opportunity.

To provide first-line assistance to field personnel in the case of sickness or injury, the following items will be immediately available:

- First aid kit
- Portable emergency eye wash
- Supply of clean water.

12.4 EMERGENCY ACTIONS

If actual or suspected serious injury occurs, these steps shall be followed:

- Remove the exposed or injured person(s) from immediate danger.
- Render first aid if necessary. Decontaminate affected personnel after critical first aid is given.
- Obtain paramedic Service or ambulance transport to local hospital. This procedure shall be followed even if there is no visible injury.
- Other personnel in the work area shall be evacuated to a safe distance until the site supervisor determines that it is safe for work to resume. If there is any doubt regarding the condition of the area, work shall not commence until all hazard control issues are resolved.
- Notify the Program Manager for Rocky Mountain Arsenal (PMRMA) of incident.

12.5 GENERAL EVACUATION PLAN

In the general case of a large fire, explosion, or toxic vapor release, a site evacuation shall be ordered and shall follow these steps:

- Sound the applicable alarm and advise the RMA fire department and PMRMA.

- Evaluate the immediate situation and downwind direction. All personnel will evacuate in the upwind direction.
- All personnel will assemble in an upwind area when the situation permits, a head count will be taken.
- Determine the extent of the problem. Dispatch a response team in protective clothing and self-contained breathing apparatus on site to evacuate any missing personnel or to correct the problem.

12.6 EMERGENCY TELEPHONE LOCATION AND CALL PROTOCOL

12.6.1 Telephone Location

A telephone will be accessible on site.

12.6.2 Emergency Phone Numbers

The following emergency phone numbers will be posted in a conspicuous location near the telephone.

Police/Fire Rescue: 911 or

RMA Fire Department
289-0187

Hospitals:

St. Anthony Hospital
2551 W. 84th Street
426-2020

Aurora Presbyterian Hospital
700 N. Potomac
360-3133

Humana Hospital
1501 S. Potomac
695-2600

12.6.3 Emergency Telephone Call Protocol

Give: Name
Telephone Number
Address
Location, if different than address

Give: Brief, accurate description of emergency.
i.e., building fire, vehicle fire, dumpster
fire, chemical fire.

i.e., personal injury from vehicle accident,
unconscious person, heat stress victim.

Do not hang up until information is repeated back to you and
accurate. Hang up only when advised to by the person who received
your call.

Notify the gate security of the expected arrival of the
responding emergency vehicle(s).

13.0 SUBCONTRACTOR SAFETY TRAINING

All OHM personnel must read and sign the worker acknowledgement (Appendix D) according to OHM standard procedure. The written verification demonstrates a full understanding of the Health and Safety Plan.

14.0 WASTE DISPOSAL PROCEDURES

14.1 GENERAL

All waste generated by this task shall be stored or accumulated in containers that meet U.S. Department of Transportation (DOT) requirements. All of the containers shall be inspected, numbered, and assigned a hazardous waste container log (HWCL) documenting the contents of the containers.

Packaging/container specifications are outlined in the Code of Federal Regulations (CFR) Chapter 49 Parts 178 and 179. These specifications will be followed.

14.2 INSPECTIONS

All containers in use that store or accumulate hazardous wastes will be inspected at least once each week-day or once each day of operation. The containers shall be checked for corrosion, leakage, overpressurization, container collapse, presence/condition of warning signs and labels.

14.3 MARKINGS

All containers used on site will be labeled to indicate:

- "Hazardous Waste"
- The date at which the waste material started accumulation
- A unique container identification number that is ~~stenciled~~ onto the container
- Hazardous waste container log.

14.4 HAZARDOUS WASTE CONTAINER LOG (HWCL)

This document provides documentation that clearly identifies the chemical composition of waste material being stored in containers.

This form is properly completed when information is present to clearly, completely and legibly identify:

- The date that the container is placed into active service
- The identification number of the container for which the HWCL identifies waste addition
- The location where the container is deployed and where waste materials were added
- The name of the person who is responsible for the maintenance of the container and the HWCL
- The location where the contents of the container were transferred and when it was removed from the location
- The date of waste movement
- Information that completely documents the accumulation of waste in the container including:
 - o The common chemical name
 - o The volume of waste material added
 - o The date of waste material addition
 - o The name of the person responsible for each waste addition.

NOTE: Estimates for waste materials added to containers should be as accurate as possible. The goal of this documentation is to

provide reasonable information describing the composition and quantity of each waste material.

14.5 CONTAMINATED WASTE DISPOSAL

Containerized materials will be turned over to the RMA contractor in charge of waste management.

14.6 DISPOSAL OF TREATED LIQUIDS BY CHEMICAL OXIDATION PROCESS

The treated liquids will be stored and sampled for applicable standards. Prior to disposal into the RMA sewer system, the liquids will be treated to meet these standards.

15.0 RECORD KEEPING

Certain health and safety related documents will be kept on file at the OHM Sacramento office at the following address:

O.H. Materials Corp.
3900 Industrial Blvd
West Sacramento, CA 95691
Attn: Richard Bohrer, CIH

These include:

- Medical records
- Certification of Hazardous Waste Operations and Emergency Response Training (29 CFR 1910.120) or equivalent
- Accident/Incident investigation reports
- Respirator fit test records
- OSHA 200 log.

Other documents are kept on site. These include:

- Safety meeting reports
- Site safety plan
- Accident/Incident investigation reports
- OSHA poster
- Air monitoring records.

16.0 SITE SECURITY

Project site areas where protective equipment is required will be designated by barrier tape (i.e., Exclusion Zone). Fenced-in areas will be secured under lock and key.

17.0 SYSTEM SAFETY HAZARD ANALYSIS REPORT

A Safety System Hazard Analysis Report (SSHAR) will be prepared for the treatment system and facility decommissioning. The SSHAR is prepared to systematically identify and evaluate both real and potential hazards, and to document procedures for elimination or control of the hazards. The SSHAR will be submitted as a separate report as required under Work Element-60. As it is an integral part of the health and safety program it is included in this health and safety plan. Although MIL-STD-882A is referenced in Data Requirement A017, the updated reference MIL-STD-882B, effective March 30, 1984, will be used as guidance for preparation of the SSHAR.

The SSHAR will consist of two sections: (1) a preliminary hazard analysis (PHA), and (2) a system hazard analysis (SHA).

17.1 PRELIMINARY HAZARD ANALYSIS

The PHA will be initiated early in the planning phase. Because data may be incomplete and informal, the PHA may undergo continual revision and updating. The PHA will include, at a minimum, the following information:

- A review of pertinent historical safety experience
- A categorized listing of basic energy sources
- An investigation of the various energy sources to determine the provisions which have been developed for their control

- Identification of the safety requirements and other regulation pertaining to personnel safety, environmental hazards, and toxic substances with which the system will have to comply
- Recommend corrective actions.

A subsystem hazard analysis will not be performed as the wastewater treatment plant is considered to be a stand alone system.

17.2 SYSTEM HAZARD ANALYSIS

The SHA will begin as the treatment system design matures and will be updated until the design is complete. Specifically, the SHA will examine the system for:

- Compliance with safety criteria
- Possible combinations of independent or dependent failures that can cause hazards to the system or personnel; failures of controls and safety devices should be considered
- How normal operations of systems and subsystems can degrade the safety of the system
- Design changes to system, subsystems, or interfaces, logic, and software that can create new hazards to equipment and personnel.

18.0 REFERENCES

- NIOSH/OSHA/USCG/EPA; Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities; DHHS(NIOSH) No. 85-115 October 1985.
- Accident Prevention Manual for Industrial Operations, National Safety Council, Chicago, Illinois, No. 121.41, 1981.
- The Condensed Chemical Dictionary, Tenth Edition, Reinhold-Van Nostrand Publishers Inc., John Wiley & Sons, New York, New York, 1981.
- Patty, Frank A., editor, Industrial Hygiene and Toxicology, Vol III, Interscience Publishers Inc., John Wiley & Sons, New York, New York, 1981.
- Code of Federal Regulations (CFR), 29 CFR Section 1910.1016, N-Nitrosodimethylamine.
- Code of Federal Regulations (CFR), 29 CFR Section 1910.120, Hazardous Waste Operations and Emergency Response.
- Code of Federal Regulations (CFR), 29 CFR Section 1910.134, Respiratory Protection Program.
- National Safety Council: Fundamentals of Industrial Hygiene, Second Edition, 1979.
- Emerson, Barnes, and Teegarden, Plague, December 15, 1976, Colorado Department of Health, Center for Disease Control, Colorado State University.

TABLES

TABLE 4-1

ANALYTICAL RESULTS - WASTEWATER FROM THE
HBSF FACILITY, RMA, COLORADO

<u>PARAMETER</u>	<u>UNIT</u>	<u>CONCENTRATION</u> ¹
Arsenic	mg/l	0.0070
Cadmium	mg/l	0.0022
Chromium	mg/l	0.0010
Lead	mg/l	0.0010
Mercury	mg/l	0.0050
Selenium	mg/l	0.0004
Silver	mg/l	0.0020
Sodium hypochlorite	mg/l	0.0250
Chlorine residuals	%	0.1400
Methylene chloride	mg/l	0.06 - 33.0
Chloroform	mg/l	<0.0005 - 15.0
1,1-Dichloroethane	ug/l	<1.7 - 1.98
1,1-Dichloroethylene	ug/l	<0.73 - 5.0
Tetrachloroethane	ug/l	<20.0
Ditmethylcyanamide	ug/l	<20.0
N-N-dimethylformamide	ug/l	<20.0
1-ethyl 1H 1,2,4-Triazole	ug/l	<20.0
Endrin	ug/l	0.0100
Lindane	ug/l	0.0100
Methoxychlor	ug/l	0.2000
Toxaphene	ug/l	0.0100
2,4,5-TP (Silvex)	ug/l	0.1000

Reference: EBASCO Services, Inc., and others, June 1988, Final Report: Hydrazine Blending and Storage Facility, Wastewater Treatment and Decommissioning Assessment, Version 3.1, Contract No. DAAK11-84-D-0017.

¹Typical concentration ranges; actual concentration may vary.

TABLE 4-2
RISK ANALYSIS

<u>HAZARD</u>	<u>EXPOSURE(1)</u>	<u>PROBABILITY(2)</u>	<u>CONSEQUENCE(3)</u>
Mechanical	CONT	LIKE	MIN-FATAL
Electrical	CONT	LIKE	MOD-FATAL
Environmental hazard	CONT	UNU	MIN-FATAL
Chemical	FREQ	UNU	CHRON-FATAL
Acoustical	CONT	UNU	CHRON
U-V light hazard	FREQ	IMP	MOD
Fire and Explosion	FREQ	LIKE	MIN-FATAL
Slip/Fall Hazard	CONT	UNU	MIN-SER

(1) Exposure: The frequency of exposure to the hazard event.

- a. CONT Continuously - many times daily
- b. FREQ Frequently - one/day or twice/day
- c. OCC Occasionally - once/week to once/month
- d. SELD Seldom - once/month to once/year.

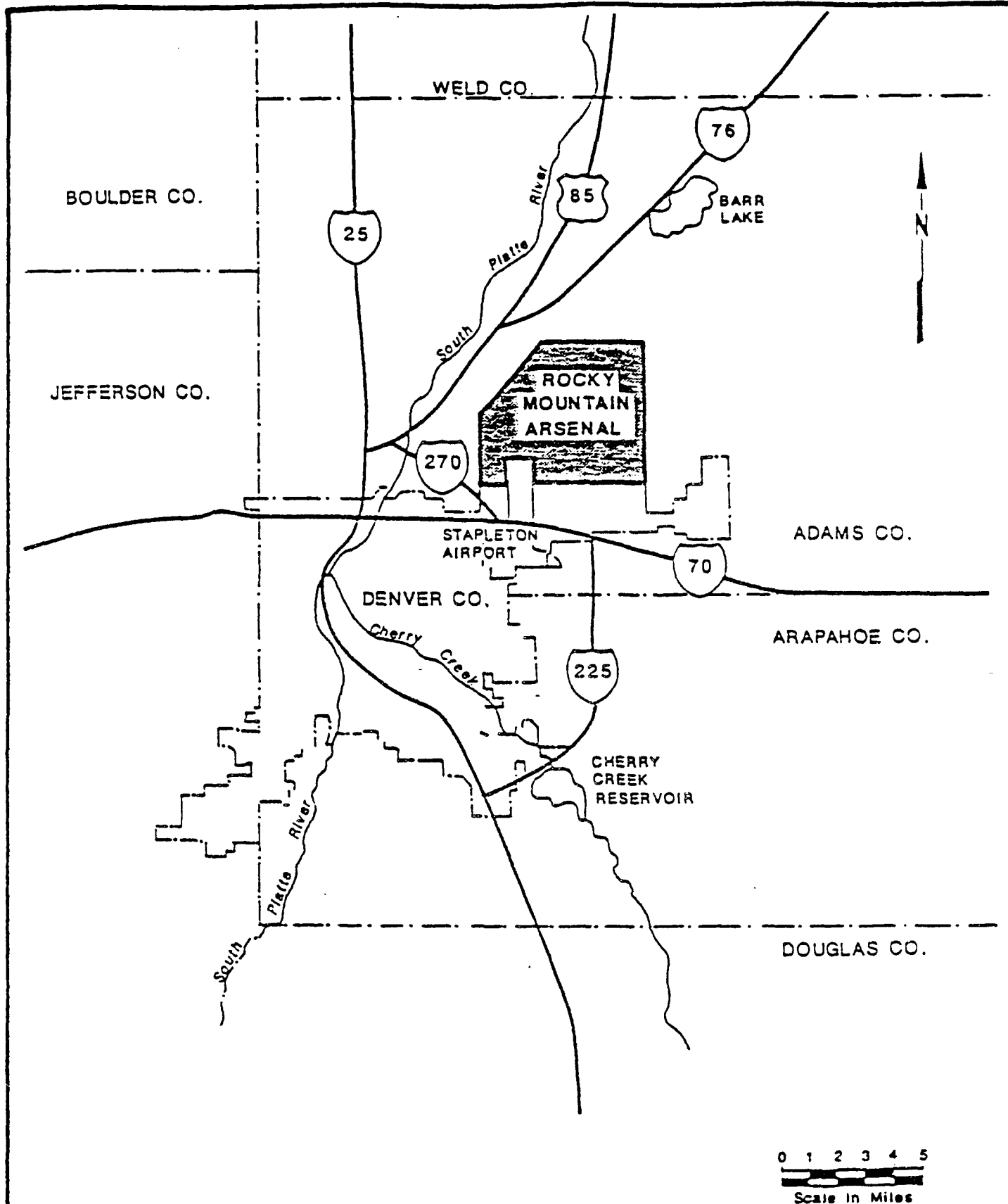
(2) Probability: The likelihood that an injury will occur upon exposure to the hazard event.

- a. CERT Certain - or almost certain
- b. LIKE Likely - not unusual, 50/50 chance of occurring
- c. UNU Unusual - would happen less often than not
- d. IMP Improbable - not likely to happen.

(3) Consequence: The degree of injury resulting from exposure to the hazard event if an injury occurs.

- a. FATAL Fatality
- b. SER Serious injury - including chemical exposure requiring hospitalization
- c. MOD Moderate injury - including chemical exposure requiring outpatient medical treatment
- d. MIN Minor injury - including chemical exposure requiring on-site first aid
- e. CHRON Chronic - Chemical, acoustical, or other exposure above TLV or other recommended standards that may not produce immediate acute effects (especially for chronic toxicants).

FIGURES

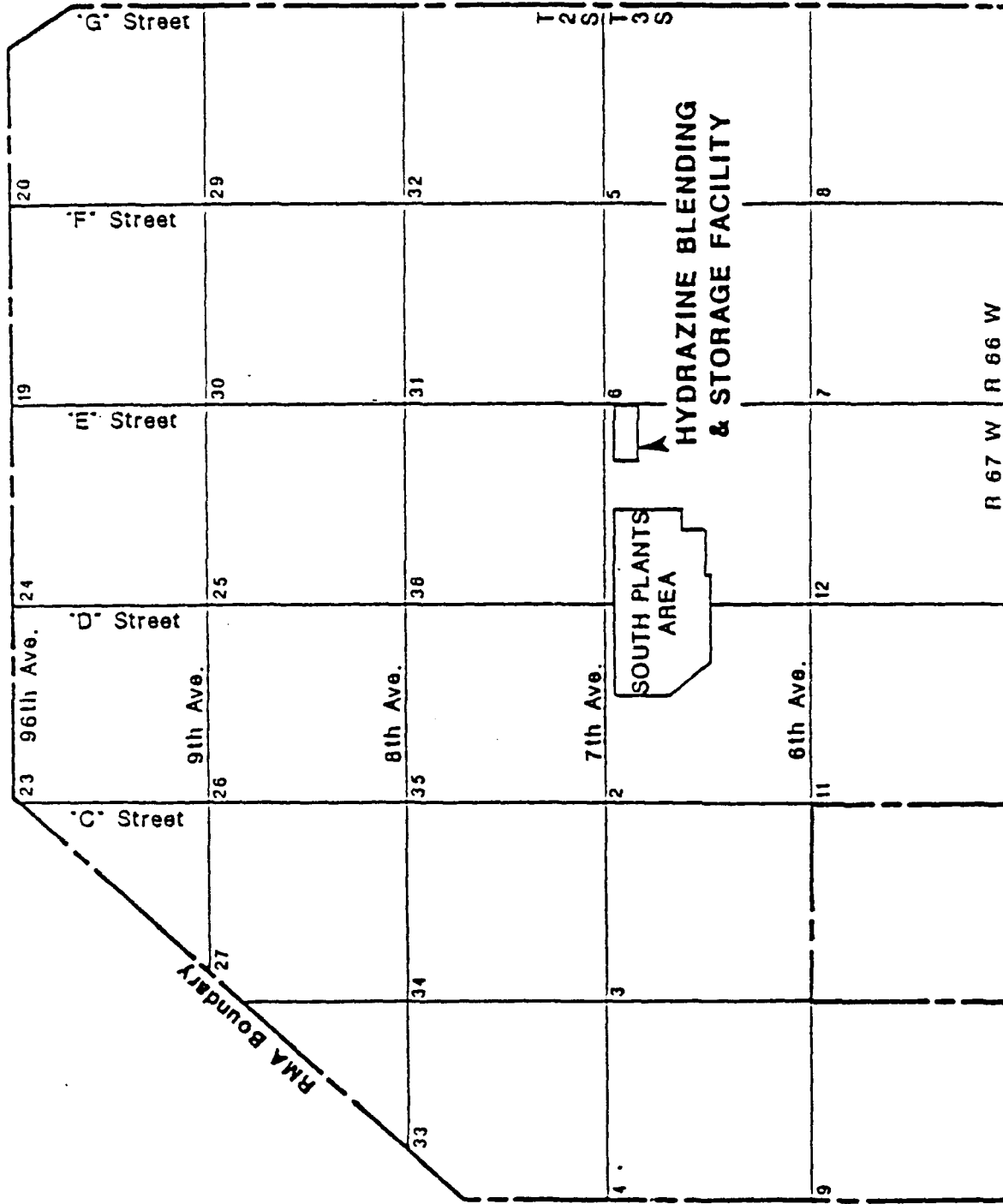


Prepared for:
U.S. Army Program Manager's Office
for Rocky Mountain Arsenal
Commerce City, Colorado

Figure 1.1
LOCATION MAP



Not to Scale



Prepared for:

U.S. Army Program Manager's Office
for Rocky Mountain Arsenal
Commerce City, Colorado

Figure 1.2

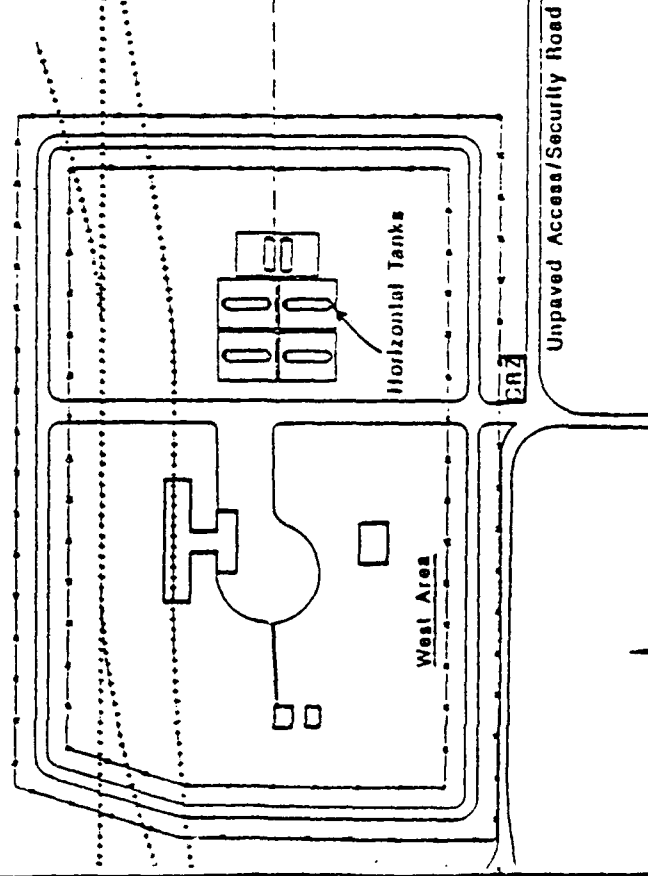
LOCATION OF HYDRAZINE BLENDING AND STORAGE FACILITY AT RMA

12S

13S

7th Ave

E STREET



EXPLANATION

- X-X-X Fence Surrounding Exclusion Zones
- CN2 Contamination Reduction Zones

N

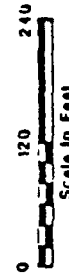


Figure 3.1

HYDRAZINE BLENDING AND STORAGE
FACILITY MAP

Prepared for:

U.S. Army Program Manager's Office
For Rocky Mountain Arsenal

Commerce City, Colorado

DRAWING NUMBER -A1

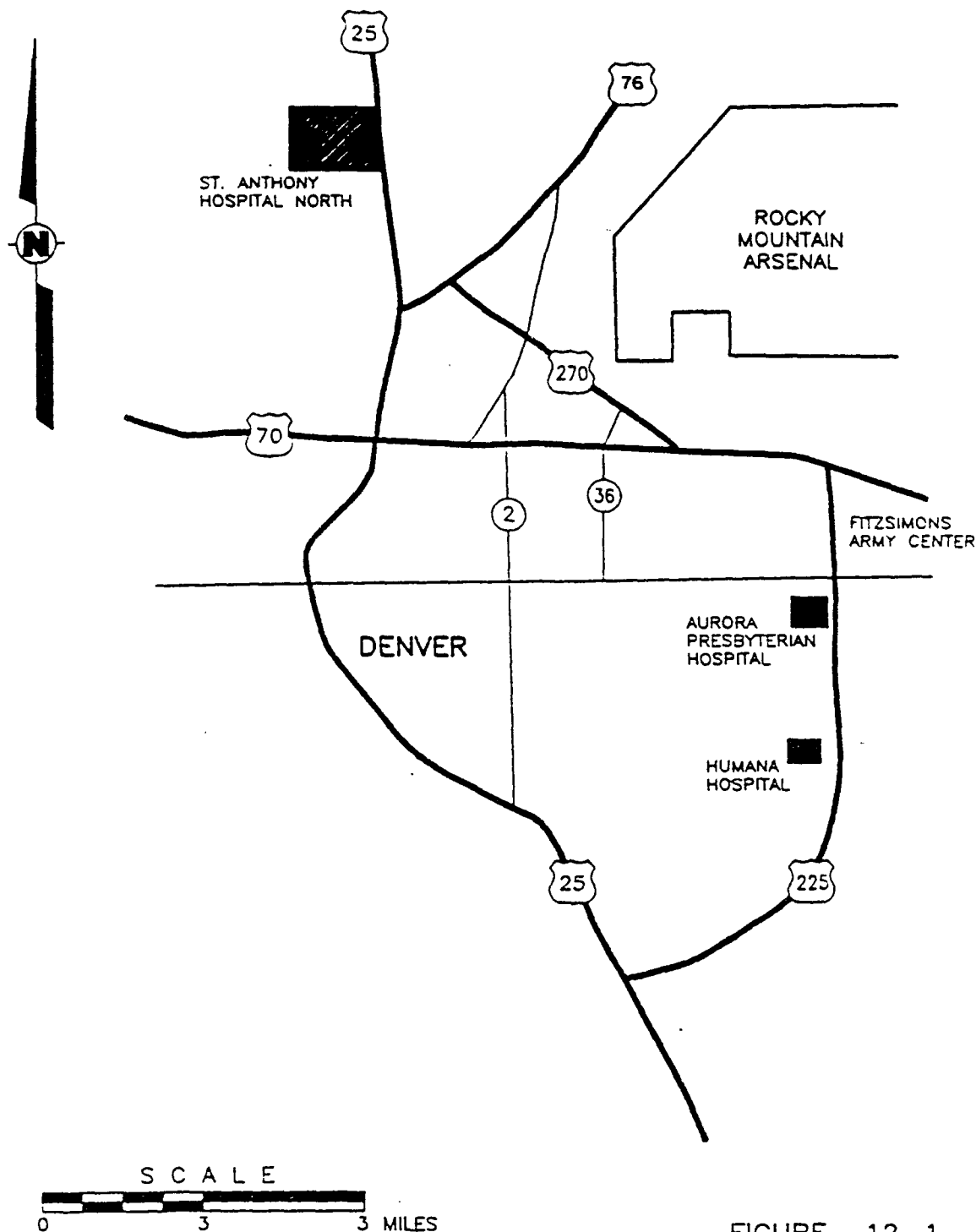
APPROVED BY

CHECKED BY

0-89

DRAWN BY
A.C. Smith

OHM CORPORATION
PITTSBURGH, PA



NOTES:

1. ST. ANTHONY HOSPITAL, 2551 W. 84TH STREET, WESTMINSTER, CO. (303)426-2020.
2. AURORA PRESBYTERIAN HOSPITAL, 700 POTOMAC, AURORA, CO. (303)360-3133.
3. HUMANA HOSPITAL, 1501 S. POTOMAC, AURORA, CO. (303)695-2600.

FIGURE 12-1

HOSPITAL LOCATIONS
HYDRAZINE BLENDING AND STORAGE FACILITY MOBILIZATION
ROCKY MOUNTAIN ARSENAL
DENVER, COLORADO

PREPARED FOR

HARDING LAWSON ASSOCIATES
NOVATO, CALIFORNIA



OHM Corporation

APPENDIX A
MATERIAL SAFETY DATA SHEETS

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



No. 34

OZONE
Revision A

Date February 1982

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: OZONE

DESCRIPTION: Electronic radiation of air provides up to 2% ozone in air for on site laboratory or commercial use. It can be produced in the liquid state, but shipping costs are too expensive. It is present in air at up to about 0.05 ppm at sea level (variable) and is produced when air is exposed to electric discharge or UV radiation.

OTHER DESIGNATIONS: O₃, CAS #010 028 156, Triatomic Oxygen

MANUFACTURED: Usually produced on-site.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Ozone gas in air	<2*	8-hr TWA 0.1 ₃ ppm** or 0.2 mg/m Human. InhalationICL
*Level of ozone attainable in "ozoneized" air. Concentrated liquid can be obtained by cooling this ozoneized air to -180 C.		ppm/time effects
**Current (1981) ACGIH TLV; also proposed OSHA Standard with an Action Level at 50% of the permissible exposure limit.		0.2/3-Hr Eye 1 Pulmonary 1.8/75 min CNS 100/1 min Skin

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C	-112	Density liquid at -183C, g/ml	1.57
Vapor density (Air=1)	1.65	Freezing point, 1 atm, deg C	-192
Water solubility at 20 C, by wt	3 ppm	Molecular weight	48.00
Critical temp, deg C	-12.1		

Appearance & Odor: A colorless to blue gas (dependent on concentration) with a pungent characteristic odor which is detectable above 0.01 ppm and becomes disagreeable (sulfur-like) above 1-2 ppm. Olfactory fatigue develops rapidly. (Also, a dark blue liquid or solid)

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
N/A	N/A	N/A		

Extinguishing media: When this material is involved in fire, use large amounts of water spray.

This material increases the intensity of combustion as compared to the burning or exploding of material in air or with a comparable amount of O₂. Firefighting procedures depend on the surrounding materials.

Self-contained breathing apparatus with full-face protection should be used by those fighting a fire in which this material is involved.

SECTION V. REACTIVITY DATA

Unstable at ordinary temperatures; spontaneously decomposes to O₂ and, thus is found in highest concentration only near the point of its generation. (It can be stored for prolonged periods as a liquid under cryogenic conditions.)

It is an oxidizing agent for both organic and inorganic materials; it is a stronger oxidizer than O₂, but less strong than fluorine. Some of its reaction products, such as ozonides formed from unsaturated hydrocarbons, can be highly explosive. Solutions containing ozone can explode on warming.

Keep away from heat, flame, strong reducing agents, and combustible materials, such as grease and oil.

NO. 34

SECTION VI. HEALTH HAZARD INFORMATION	TLV 0.1 ppm
<p>Excessive exposure is highly irritating and can be damaging to the eyes, nose, throat, and lungs. Exposure above 0.1 ppm causes drying of the mucous membranes of the mouth nose and throat. A short exposure at 1-2 ppm produces headache as well as irritation of the respiratory tract, but symptoms subside when exposure stops. High concentrations and/or excessive duration of exposures above the TLV can produce nausea, pain in chest, cough, dyspnea, reduced visual acuity, fatigue, and pulmonary edema. Inhalation of >20 ppm for an hour or more (or 50 ppm for 1/2 hour) could be fatal. Symptoms of edema from excessive exposure can be delayed one or more hours. Acute damage from ozone appears to be mainly from its oxidizing effect on contact with tissue, but it may have chronic effects on the lungs and on lung tumor acceleration.</p> <p>FIRST AID:</p> <p><u>Eye Contact:</u> Get prompt medical help.</p> <p><u>Inhalation:</u> Remove to ozone-free air. Get medical help. Keep warm, quiet and at rest and observe for delayed pulmonary edema. Administration of O_2 has been recommended if breathing is labored.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Evacuation of workers should be planned prior to emergency condition. Approved self-contained respiratory equipment with full face protection should be used by those involved in handling leaks and in emergency conditions. Detect leaks by exposing paper impregnated with 4% potassium iodide (dried) to suspected area. Paper turns brown if ozone is present.</p> <p>Provide ventilation to dilute and disperse small amounts of ozone into the outside atmosphere.</p> <p>Follow Federal, State and local regulations.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide general and local exhaust ventilation to meet TLV requirements in the workplace. Respirators of approved types must be available where overexposure to ozone is possible in a workplace. All exposures above 1 ppm must use full face protection, and exposures above 5 ppm require an air-supplied or self-contained respirator. Cartridge or gas mask-type respirators with organic vapor-type cartridge(s) or canister are suitable only below 5 ppm ozone.</p> <p>Where ozone is generated (or where liquid ozone is stored or used) explosion hazard and health hazards will exist and must be guarded against by proper planning, equipment, training, and work practice.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Exclude from industrial exposures to ozone those individuals with a history of heart or lung problems. Also certain individuals may be more susceptible to injury from ozone exposure than others; because of a certain enzyme deficiency they may become ill from exposures which are readily endured by a normal worker.</p> <p>[see Calabrese, et, al. <u>J. Toxicol. Health</u> 2 (1977) 909]</p>	
<p>2,4-9,12,14,16,17,27,31,37, DATA SOURCE(S) CODE: 18.47 (See also ASTM E591)</p> <p><small>I warrant as to the quality of information herein for purposes of purposes and necessary purposes of necessity. Therefore, sufficient reasonable care has been taken in the preparation of such information. Genium Publishing Corporation assumes no responsibility, makes no representations and assumes no responsibility as to the accuracy or quality of such information for application to purposes or purposes of purposes or for representations of its use.</small></p>	<p>APPROVALS: MIS CRD <i>J. M. Niles</i></p> <p>Industrial Hygiene and Safety <i>JW</i> 2-4-82</p> <p>MEDICAL REVIEW: 10 February 1982</p>

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN STREET
SCHENECTADY, NY 12303-1836 USA
(518) 377-8855



GENIUM PUBLISHING CORP.

NO. 176

HYDRAZINE, ANHYDROUS

DATE June 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: HYDRAZINE, ANHYDROUS
OTHER DESIGNATIONS: Diamine, CAS #000 302 012, NH₂NH₂
MANUFACTURER: Available from several suppliers, including:
Olin Chemicals Tel: (203) 356-2473
120 Long Ridge Road
Stamford, CT 06904

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Hydrazine	ca 99	8-hr TWA 0.1 ppm or 0.1 mg/m ³ (skin)* Rat, Inhalation LC ₅₀ 570 ppm/4H Mouse, Oral TDLo 1951 mg/kg/2Y- Neoplastic Effects Rabbit, Skin LD ₅₀ 91 mg/kg Mouse, Intraperitoneal LD ₅₀ 163 mg/kg TDLo 400 mg/kg 2Y-1 Carcinogenicity

*ACGIH TLV (1983): listed as an industrial substance suspected of carcinogenic potential for man.
OSHA PEL is 1 ppm or 1.3 mg/m³.
NIOSH (1978) has recommended a ceiling level of 0.03 ppm or 0.04 mg/m³, determined by any 2-hour sample.
Hydrazine and salts are carcinogenic in mouse and rat tests. IARC, Vol 4, pp. 127-136 (1974).
Possible fetal malformation has also been reported.

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C	113.5	Specific gravity, 25/4 C	1.004
Vapor pressure at 20 C, mm Hg	10.4	Melting point, deg C	1.4
Vapor density (H ₂ O=1)	1.1	Viscosity at 25 C, cp	0.90
Solubility in water	Miscible	Molecular weight	32.06

Appearance & Odor: Colorless, fuming, hygroscopic liquid with an ammonia-like, penetrating odor. Threshold odor conc.: 3-4 ppm. Sense of smell can be desensitized rapidly; not considered to have good warning properties. Take immediate protective action if odor or irritancy detected.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Auto-ignition Temp.	Flammability Limits in Air	Lower	Upper
>100 F (TCC)	varies with surface ~74-518 F	± by volume	4.7	100**

Extinguishing Media: water, dry chemical and carbon dioxide can be used on small fires.
Flooding amts. of water needed to prevent re-ignition (cool surroundings, raise Fl. Pt.)
Fight fires from safe distance and protected location. Use water spray to cool fire-exposed containers, to disperse vapors, and to dilute spills to nonflammable mixtures.
Vapor is highly flammable & a severe explosion hazard with oxidizers or on heating.
Firefighters need self-contained respirator, eye protection and full protective clothing.
*Iron oxide catalyzes reaction with air at 74F; stainless steel at 313 F; glass at 518 F.
**Hot hydrazine vapor can undergo exothermic degradation in absence of air.

SECTION V. REACTIVITY DATA

This reactive chemical is stable in suitable closed containers at room temperature under inert atm., in the absence of UV radiation. It does not polymerize and is not shock or friction sensitive. Hydrazine is reported to be thermally stable at 250C.
It is a weak base & a highly active reducing agent, especially under basic conditions.
It is incompatible with oxidizing agents (including air), acids, some metal oxides (Fe, Cu, Mo for example), and some metals (carbon steel, copper, zinc, 316 St. steel for example); hypergolic with strong oxidants (for example peroxides, HNO₃, chromates); spontaneous ignition in air on porous materials (paper, wood, cloth, asbestos, dry soil).
It is incompatible with glass, polyethylene, PTFE, PCFTE, graphite, chrome plate, some stainless steels, INCONEL, and some aluminum alloys. Prevent contamination!
Degradation products include NO_x (oxidative); N₂, NH₃, & H₂ (catalytic).

NO. 126

SECTION VI. HEALTH HAZARD INFORMATION

TLV 0.1 ppm (skin) (See Sect II)

Hydrazine is poisonous, very toxic by ingestion, inhalation and skin absorption (acute or chronic). Early systemic effects from chronic excessive exposure include anorexia, weight loss, weakness & tremors. Overexposure to vapors can immediately irritate nose & throat, followed by itching, burning & swelling of the eyes (possible temporary blindness if exposure severe), and possible dermatitis. 80 ppm IDLH is reported. Systemic effects can include dizziness, nausea, convulsions and sensitization. Liquid contact can be corrosive to tissue, producing penetrating burns and possible permanent corneal opacity. Systemic toxicity: Liver, kidneys & blood forming system.

FIRST AID:

EYE or Skin Contact: Immediately flush with running water! Continue eye flushing for at least 15 min, including under eyelids. Remove contaminated clothing under safety shower. Contact physician! Continue flushing with water. Skin burns to be treated like alkali or thermal burns.

Inhalation: Remove to fresh air. Restore and/or support breathing. Contact physician! Keep warm and at rest. Pulmonary edema may occur from severe exposure.

Ingestion: Promptly give 2-3 glasses of milk, water or citrus juice to drink and induce vomiting. Repeat. Contact physician!

*Concentration considered immediately dangerous to life and health

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Institute plan, prepared with supplier's guidance. Notify safety personnel of spills. Evacuate all except trained clean-up personnel who are protected against inhalation & contact. Use optimum explosion-proof ventilation. Remove sources of heat or ignition.

Promptly dilute spill with water spray to less than 40% hydrazine to control fire hazard; flush to provided containment or otherwise contain and collect liquid as may be feasible. Use sand (not combustible absorbent) to collect small spills and residues, & place in closed containers for disposal. Flush spill area with much water.

DISPOSAL: Follow Federal, State, and Local regulations. 2% solns can be decomposed with hypochlorite or 10% H₂O₂. The Air Force has used special mobile incinerators for hydrazine or its mixtures with water (NO_x evolution). Open pit burning of alcohol solutions has been reported. Dil. sulfuric acid has been used for neutralization of aq. hydrazine. EPA (RCRA) HW No. is U133 (40 CFR 261).

SECTION VIII. SPECIAL PROTECTION INFORMATION

Use explosion-proof general and exhaust ventilation to meet TLV (exhaust scrubber may be needed). Use enclosed processes where feasible. Approved self-contained respirator with full facepiece can be used in a pressure-demand mode for non-routine conditions to 80 ppm or for emergency escape. Hoods should have 150 lfm face velocity.

NIOSH recommends using a regulated work area, excluding unauthorized personnel.

Use impervious* body-covering protection (rubber gloves, apron, boots, full suit, etc.) as conditions require to prevent skin contact. Use chemical safety goggles and faceshield to protect eyes. Contaminated impervious protection to be thoroughly washed off with water before & during removal. Contaminated clothing & equipment are fire & health hazard. Wear clean work clothing. Shower after work. Control laundering and cleaning procedure that is used for hydrazine contaminated items. Destruction of contaminated leather has been recommended.

Eyewash fountains, washing facilities and safety showers to be readily available where hydrazine is used or handled or stored. *Butyl rubber has been recommended.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed containers in a clean, cool, well-ventilated area with controlled drainage, away from oxidizing agents, acids, direct sunlight, & sources of heat or ignition. Water sprinkler-protected, sheltered, outside or detached storage preferred. Protect containers from physical damage; ground & bond for transfers to prevent static sparks; inert with nitrogen atmosphere. Prevent contamination of hydrazine. Concrete pads, dikes, drains and containment have been recommended for large tanks and drums. Avoid breathing & contact with vapors! Prevent liquid contact with eyes, skin or clothing! Do not ingest! Practice good personal hygiene. Wash well after handling. Observe label precautions. Rigidly follow proper handling requirements. Obtain guidance from supplier. Use with proper ventilation.

DOT Classification: FLAMMABLE LIQUID I.D. No. UN2029 Label: FLAMMABLE LIQUID, POISON, CORROSIVE

IMO Class: 3.3

DATA SOURCE(S) CODE: 1-12,14,16,19, 20,23,25,26,31,37,38,42,47-49,52

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APPROVALS: MIS/CRD

INDUST HYGIENE SAFETY

MEDICAL REVIEW: 15 June 1984

IDENTITY

NTP PREFERRED NAME: Methylhydrazine

Synonyms:

Hydrazine, methyl-
Monomethyl hydrazine

CAS Registry Number:

60-34-4

NIOSH Registry Number:

MV5600000

Formula: CH_6N_2

Molecular Weight: 46.09

WLN: ZM1



PHYSICAL

PROPERTIES

Physical Description: Colorless liquid

Melting Point: -20.9°C Boiling Point: 87.5°C Density: 0.87 g/mL at 25°C Specific Gravity: 0.874 at $20^\circ/4^\circ\text{C}$

Flammability: Flammable

Stability: Hygroscopic; stable if no
in contact with copper,
iron, or their alloys.Flash Point: 16.7°C (62°F)Reactivity: Strong reducing agent. Ignites spontaneously on contact with
strong oxidizing agents such as fluorine, chlorine trifluoride,
nitrogen tetroxide, and fuming nitric acid.Solubility In: Water: ≤ 1 mg/mL at 24°C

Acetone: Not available

DMSO: ≥ 10 mg/mL at 24°C

Ether: Soluble

Ethanol: ≥ 10 mg/mL at 24°C

Benzene: Not available

Other Physical Data: Amine-like odor; Refractive Index is 1.4325 at 20°C ;
vapor density is 1.6, ignition temperature is 196°C ; vapor pressure is 4
mm Hg at 25°C , Melting point is -52.4°C , soluble in hydrocarbons.

SHIPPING

D.O.T. Shipping Name: Methylhydrazine

D.O.T. Identification Number: UN1244

D.O.T. Hazard Classification: Flammable liquid

Other Shipping Regulations: Flammable liquid and poison label required;
forbidden on passenger aircraft; cargo aircraft limit is 5 pt.Exceptions: None. Specific Requirements, 173.145 in Hazardous Materials
Regulations of the Department of Transportation (1981).

Acute Hazards: Toxic, irritant

Symptoms: Tremors and convulsions; inhalation causes local irritation of respiratory tract, respiratory distress and systemic effects; contact of liquid with eyes or skin causes irritation and burns; ingestion causes irritation of mouth and stomach; hemolytic anemia.

Exposure Limits: The ACGIH listed this compound to be a suspected human carcinogen. The TWA is 0.2 ppm.

Skin Contact: Flood all areas of body that have contacted the substance with water. Don't wait to remove contaminated clothing; do it under the water stream. Use soap to help assure removal. Isolate contaminated clothing when removed to prevent contact by others.

Eye Contact: Remove any contact lenses at once. Flush eyes well with copious quantities of water or normal saline for at least 20-30 minutes. Seek medical attention.

Inhalation: Leave contaminated area immediately; breathe fresh air. Proper respiratory protection must be supplied to any rescuers. If coughing, difficult breathing or any other symptoms develop, seek medical attention at once, even if symptoms develop many hours after exposure.

Ingestion: If convulsions are not present, give a glass or two of water or milk to dilute the substance. Assure that the person's airway is unobstructed and contact a hospital or poison center immediately for advice on whether or not to induce vomiting.

Storage Precautions: Store in an explosion-proof refrigerator and keep away from moisture, metals and oxidizers.

Spills and Leakage: Use absorbent paper to pick up spilled material. Follow by washing surfaces well with alcohol. Seal all wastes in vapor-tight plastic bags for eventual disposal.

Suggested Gloves: Literature indicates that butyl rubber or PVC gloves may provide protection from exposure to this compound.

Uses: Rocket fuel, intermediate in chemical synthesis, solvent.

Additional Reference Sources:

Merck Index, M. Windholz et al, 9th Ed., p. 794 (1976), Merck.

Patty's Industrial Hygiene and Toxicology, G. C. Clayton and F. E. Clayton, 3rd Revised Ed., p. 2794 (1981), John Wiley and Sons.

Hazardous Chemicals Data Book, G. Weiss, p. 614 (1980), Noyes.

HEALTH
HAZARDS

FIRST
AID

ADDITIONAL
INFORMATION



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A-7

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2

M A T E R I A L S A F E T Y D A T A S H E E T

DATE: 01/27/86

CUST # 100501 P.O. # C339864BL

PA

SECTION I PRODUCT IDENTIFICATION

010100-8 1,1-DIMETHYLHYDRAZINE, 94% ODPH
CAS # 57-14-7
MOLECULAR FORMULA: C₂H₆N₂

SECTION II TOXICITY HAZARDS

RTECS # MV2450000
HYDRAZINE, 1,1-DIMETHYL-

ORL-RAT LD50:122 MG/KG HEPAAX 24,71,73
IHL-RAT LC50:252 PPM/4H AMIAB 12,609,55
IPK-RAT LD50:102 MG/KG TXAPA9 6,371,64
IVN-RAT LD50:119 MG/KG HEPAAX 24,71,73
URL-MUS LD50:1205 MG/KG HEPAAX 24,71,73
IHL-MUS LC50:172 PPM/4H AMIAB 12,609,55
IPR-MUS LD50:129 MG/KG AMRL* TR-69-130,69
SCU-MUS LD50:12 MG/KG BIJOAK 122,121,71
IVN-MUS LD50:250 MG/KG HEPAAX 24,71,73
IHL-DUG LC50:3560 PPM/15H AIHAAP 24,137,63
IVN-DUG LD50:100 MG/KG HEPAAX 24,71,73
IHL-HAM LC50:342 PPM/4H AMIAB 12,609,55
CARCINOGENIC REVIEW: ANIMAL POSITIVE IARC* 4.137,74
TLV-TWA 0.5 PPM; STEL 1 PPM (SKIN) DTLVS* 4.149,80
TLV-SUSPECTED CARCINOGEN DTLVS* 4.149,80
OSHA STANDARD-AIR: TWA 1 MG/M³ (SKIN) (SCP-K) FEREAL 39:23540,74
OCCUPATIONAL EXPOSURE TO HYDRAZINES RECM STD-AIR: CL 0.15 MG/M³/2H
NTP FOURTH ANNUAL REPORT ON CARCINOGENS, 1985
"NIOSH MANUAL OF ANALYTICAL METHODS" VOL 1 248, VOL 3 5143 NIMAM*
"NIOSH MANUAL OF ANALYTICAL METHODS" TO BE REVISED BY JUNE, 1986
REPORTED IN EPA TSCA INVENTORY, 1983
EPA GENETIC TOXICOLOGY PROGRAM, JANUARY 1984
MEETS CRITERIA FOR PROPOSED OSHA MEDICAL RECORDS RULE FEREAL 47.304,10.
82

SECTION III PHYSICAL DATA

BUILDING POINT: 62 C TO 64 C/753MM.
DENSITY: 0.791

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT: 34 F

EXTINGUISHING MEDIA:

WATER SPRAY.

CARBON DIOXIDE, DRY CHEMICAL POWDER, ALCOHOL OR POLYMER FOAM.

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Belgium

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Montreal, Quebec H3M 2M7
Canada

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France

Japan

Aldrich Japan
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Japan

United Kingdom

Aldrich Chemical Co. Ltd.
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1000
2

M A T E R I A L S A F E T Y D A T A S H E E T

DATE: 01/27/00 CATALOG # 016160-A CUST # 100501 P.O. # D334807BL

PAGE:

SPECIAL FIRE FIGHTING PROCEDURES:

WEAR SELF-CONTAINED BREATHING APPARATUS AND PROTECTIVE CLOTHING TO PREVENT CONTACT WITH SKIN AND EYES.

UNUSUAL FIRE AND EXPLOSION HAZARDS:

FLAMMABLE LIQUID.
VAPOR MAY TRAVEL CONSIDERABLE DISTANCE TO SOURCE OF IGNITION AND FLASH BACK.
UNDER FIRE CONDITIONS, MATERIAL MAY DECOMPOSE TO FORM FLAMMABLE AND/OR EXPLOSIVE MIXTURES IN AIR.
CATCHES FIRE IF EXPOSED TO AIR.

SECTION V HEALTH HAZARD DATA

DANGER
POISON
MAY BE FATAL IF INHALED, SWALLOWED, OR ABSORBED THROUGH SKIN.
CAUSES BURNS.
EASILY ABSORBED THROUGH SKIN.
CARCINOGEN.
VAPOR OR MIST IS IRRITATING TO THE EYES, MUCOUS MEMBRANES AND UPPER RESPIRATORY TRACT.
EXPOSURE CAN CAUSE:
DAMAGE TO THE LIVER
DAMAGE TO THE KIDNEYS
BLOOD EFFECTS
GASTROINTESTINAL DISTURBANCES
FIRST AID:
IN CASE OF CONTACT, IMMEDIATELY FLUSH EYES OR SKIN WITH CUPIOUS AMOUNTS OF WATER FOR AT LEAST 15 MINUTES WHILE REMOVING CONTAMINATED CLOTHING AND SHOES.
ASSURE ADEQUATE FLUSHING OF THE EYES BY SEPARATING THE EYELIDS WITH FINGERS.
IF INHALED, REMOVE TO FRESH AIR. IF NOT BREATHING GIVE ARTIFICIAL RESPIRATION, PREFERABLY MOUTH-TO-MOUTH. IF BREATHING IS DIFFICULT, GIVE OXYGEN.
CALL A PHYSICIAN.
DISCARD CONTAMINATED CLOTHING AND SHOES.

SECTION VI REACTIVITY DATA

INCOMPATIBILITY:

OXIDIZING AGENTS
COPPER, COPPER ALLOYS
BRASS
IRON AND IRON SALTS

HAZARDOUS DECOMPOSITION PRODUCTS:

NITROGEN OXIDES
TOXIC FUMES

SECTION VII SPILL OR LEAK PROCEDURES

USA	Belgium	Canada	France	Japan	United Kingdom	West Germany
Aldrich Chemical Co. 307 West 31st Ave. Milwaukee, WI 53212 (414) 273-3850 Telex 910 282 385 Toll-free 800 421 9700	Aldrich Chemie S.A. NV 8 Rue Capart 1180 Brussels Belgium	Aldrich Chemical Co. (Canada) Ltd. 1411 Port St. Joseph Montreal, Quebec H3M 2H7 Canada	Aldrich-Chemie S.r.l. 27, Rue de la Trêve F-93 000 St. Maurice France	Aldrich Japan Co. Agency Bldg. 10 Kyama 1-chome Chiyoda-ku, Tokyo Japan	Aldrich Chemical Co. Ltd. The Old Brickyard, New Road Culhampton, Dorset SP8 4JL England	Aldrich Chemie GmbH & Co. D-7120 Sindelfingen West Germany

SAFETY

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May 2.89 10:35 P.04

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M A T E R I A L S A F E T Y D A T A S H E E T

DATE: 01/27/90 CATALOG # D16160-R CUST # 100501 P.O. # D339869BL

PAGE

SPILLS OR LEAKS:

EVACUATE AREA.

SHUT OFF ALL SOURCES OF IGNITION.

WEAR SELF-CONTAINED BREATHING APPARATUS, RUBBER BOOTS AND HEAVY RUBBER GLOVES.

ABSORB ON SAND OR VERMICULITE AND PLACE IN CLOSED CONTAINERS FOR DISPOSAL.

VENTILATE AREA AND WASH SPILL SITE AFTER MATERIAL PICKUP IS COMPLETE.

WASTE DISPOSAL:

BURN IN A CHEMICAL INCINERATOR EQUIPPED WITH AN AFTERBURNER AND SCRUBBER BUT EXERT EXTRA CARE IN IGNITING AS THIS MATERIAL IS HIGHLY FLAMMABLE.

OBSERVE ALL FEDERAL, STATE & LOCAL LAWS CONCERNING HEALTH & POLLUTION.

SECTION VIII PRECAUTIONS TO BE TAKEN IN HANDLING AND STORAGE

DANGER

POISON

CORROSIVE.

CARCINOGEN.

DO NOT BREATHE VAPOR.

DO NOT GET IN EYES, ON SKIN, ON CLOTHING.

WEAR APPROPRIATE OSHA/MSHA-APPROVED RESPIRATOR, CHEMICAL-RESISTANT GLOVES, SAFETY GOGGLES, OTHER PROTECTIVE CLOTHING.

USE WITH ADEQUATE VENTILATION.

USE ONLY IN A CHEMICAL FUME HOOD.

IN CASE OF EXPOSURE, OBTAIN MEDICAL ATTENTION IMMEDIATELY.

FLAMMABLE.

KEEP AWAY FROM HEAT AND OPEN FLAME.

AIR-SENSITIVE.

HYGROSCOPIC.

PROTECT FROM MOISTURE.

HANDLE AND STORE UNDER NITROGEN.

REFRIGERATE.

SECTION IX SPECIAL PRECAUTIONS AND COMMENTSWARNING: UDMH CAN CAUSE CONVULSIONS
RESULTING IN DEATH, PULMONARY EDEMA,
CNS STIMULATION AND HEMOLYTIC ANEMIA.THE ABOVE INFORMATION IS BELIEVED TO BE CORRECT BUT DOES NOT PURPORT
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8 Rue Cassini Cloos
B-1070 Brussels
Belgium

Canada

Aldrich Chemical Co.
1000 Lakeshore Blvd.
1411 Port St. Joseph
Montreal, Quebec H3M 2M7
Canada

France

Aldrich-Chemie S.R.L.
27, Fosse des Tanneurs
F-67 020 Strasbourg
France

Japan

Aldrich Japan
c/o Kyodo Sangyo Kaisha Ltd.
10 Kanda-Honmaru
Chiyoda-Ku, Tokyo
Japan

United Kingdom

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The Old Brewery, New Road
Gillingham, Dorset SP8 4LN
England

West Germany

Aldrich Chemie GmbH
D-7521 Brennen
West Germany

IDENTITY

NTP PREFERRED NAME: N-Nitrosodimethylamine

Synonyms:

N-Methyl-N-nitroso-
methanamine
N-Nitroso-dimethylamine
Dimethylnitrosoamine

CAS Registry Number:

62-75-9

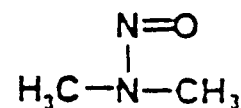
NIOSH Registry Number:

IQ0525000

Formula: C₂H₆N₂O

Molecular Weight: 74.08

WLN: ONN1&1



PHYSICAL

PROPERTIES

Physical Description: Clear, yellow liquid

Melting Point: Not available

Boiling Point: 151°C

Density: 1.01 g/mL

Specific Gravity: 1.0059 at 20°/4°C

Flammability: Combustible

Stability: Sensitive to UV light.

Flash Point: 61°C (142°F)

Reactivity: May react with strong oxidants, especially peracids.

Solubility In: Water: ≥100 mg/mL at 19°C Acetone: ≥100 mg/mL at 19°C

DMSO: ≥100 mg/mL at 19°C Ether: Soluble

Ethanol: ≥100 mg/mL at 19°C Benzene: Soluble

Other Physical Data: Refractive Index is 1.4368 at 20°C; Lipophilic.

SHIPPING

D.O.T. Shipping Name: Poisonous liquid, N.O.S.

D.O.T. Identification Number: UN2810

D.O.T. Hazard Classification: Poison B

Other Shipping Regulations: Poison label required. Passenger aircraft limit is 1 qt; cargo aircraft limit is 55 gal.

Exceptions: 173.345. Specific Requirements, 173.346 in Hazardous Materials Regulations of the Department of Transportation (1981).

HEALTH HAZARDS

Acute Hazards: Very toxic; can be absorbed through the skin.

Symptoms: Headaches, fever, weakness, nausea, vomiting, abdominal pain, diarrhea, gastrointestinal hemorrhage, hepatomegaly, jaundice and ascites.

Exposure Limits: OSHA standard: human carcinogen (avoid all contact).

FIRST AID

Skin Contact: Flood all areas of body that have contacted the substance with water. Don't wait to remove contaminated clothing; do it under the water stream. Use soap to help assure removal. Isolate contaminated clothing when removed to prevent contact by others.

Eye Contact: Remove any contact lenses at once. Flush eyes well with copious quantities of water or normal saline for at least 20-30 minutes. Seek medical attention.

Inhalation: Leave contaminated area immediately; breathe fresh air. Proper respiratory protection must be supplied to any rescuers. If coughing, difficult breathing or any other symptoms develop, seek medical attention at once, even if symptoms develop many hours after exposure.

Ingestion: If convulsions are not present, give a glass or two of water or milk to dilute the substance. Assure that the person's airway is unobstructed and contact a hospital or poison center immediately for advice on whether or not to induce vomiting.

ADDITIONAL INFORMATION

Storage Precautions: Store in a refrigerator and protect from prolonged exposure to light.

Spills and Leakage: Use absorbent paper to pick up spilled material. Follow by washing surfaces well with soap and water. Seal all wastes in vapor-tight plastic bags for eventual disposal.

Suggested Gloves: Not available

Uses: Manufacture of dimethylhydrazine; also used as rocket fuel, solvent and rubber accelerator.

Additional Reference Sources:

Handbook of Toxic and Hazardous Chemicals, M. Sittig, p. 502 (1981), Noyes.

Merck Index, M. Windholz et al, 9th Ed., p. 862 (1976), Merck.

Condensed Chemical Dictionary, G. Hawley, 9th Ed., p. 737 (1977), Van Nostrand Reinhold.

MATERIAL SAFETY DATA SHEET

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No. 15A

CHRYSOTILE ASBESTOS

Date November 1979

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CHRYSOTILE ASBESTOS

DESCRIPTION: A crystalline serpentine mineral, or layered hydrated magnesium silicate in fine fiber form (asbestiform). The end of a sliver of this material with a cross-section of 0.1 mm can show about 20 million tubules (scroll-like fibrils about 0.01 μ m diameter) in approximate parallel orientation. It is possible to strip from a fiber bundle very fine chrysotile threads, each an agglomerate of hundreds or thousands of hollow fibrils. (90% of asbestos used is chrysotile.)

OTHER DESIGNATIONS: Asbestos, CAS #001 332 214, GE Material D4E11

SECTION II. INGREDIENTS AND HAZARDS

Idealized Chrysotile (unit cell) - $Mg_3Si_2O_5(OH)_4^*$

ca 95

HAZARD DATA

8-hr TWA 2 fibers/cc,*
Ceiling 10 fibers/cc.
($>5 \mu$ m in length)

"Asbestos"

Human, Inhal.

TDLo 1.2 fb/cc for
19 years

(Pulmonary effects)

*Impurities include low levels of Mn, Fe^{+2} , Fe^{+3} , and Al in the structure, replacing randomly 4% av. of the Mg atoms. Impurities depend on the mineral source; the unit cell hydroxyl content can also vary with an average of 4.25.

**Current OSHA TLV. OSHA (1975) proposed TLV of 0.5 fb/cc with a Ceiling of 5 fb/cc (15 min. sample). NIOSH (1976) proposed 0.1 fb/cc. ACGIH (1979 Intended Changes List) has retained TLV of 2 fb/cc for chrysotile asbestos. Asbestos is carcinogenic and/or co-carcinogenic for humans!

SECTION III. PHYSICAL DATA

Melting point _____ Decomposes (see Sect. V)

Vapor pressure _____ Nil

Water solubility _____ Insoluble (slowly breaks down in hot water)

Appearance: White, fibrous solid, as long flexible textile fibers down to dust-like filler power. (Milled chrysotile asbestos (powder-like) has an aspect ratio (ratio of length/diameter) as high as 50 for most particles.)

SECTION IV. FIRE AND EXPLOSION DATA

LOWER UPPER

Flash Point and Method

Autoignition Temp.

Flammability Limits in Air

N/A

N/A

N/A

This material is not combustible in air. Use extinguishing media as appropriate for the surrounding materials in a fire situation.

SECTION V. REACTIVITY DATA

This material is inert under ordinary room temperature and heated use conditions. It is resistant to heat, but it will decompose and alter its microscopic fiber structure (see Sect. I) above 600 C (1112 F): Chrysotile dehydroxylates at 600-780 C; the "asbestos anhydride" in turn breaks down to mixture of silica (SiO_2) and forsterite (Mg_2SiO_4) at 800-850 C. Above 1000 C (1832 F) magnesium pyroxenes are formed which melt at about 1450 C.

Strong acids can attack chrysotile and rapidly extract its MgO and H_2O content; it can be decomposed by glacial acetic acid. Hot water slowly breaks down chrysotile. It, like other forms of asbestos, resists strong alkali (5 M NaOH at least up to 100 C).

NO. 15A

SECTION VI. HEALTH HAZARD INFORMATION	TLV 2 fibers/cc >5 um in length (See Sect. II)
<p>As a particulate material, chrysotile asbestos can be irritating to the respiratory tract, skin or eyes. However, the significant industrial hazards arise from excessive dust inhalation with damage requiring years to become evident. Chronic inhalation of high levels of asbestos particles can produce asbestosis, a disabling fibrosis of the lungs which gradually reduces lung capacity and efficiency. (Usually over 4 years is required for a serious condition to develop.) Excessive inhalation can also cause pleural plaques, a thickening of the lung lining. Compliance with TLV is expected to control these hazards. Cancer can result from excessive inhalation of asbestos particulate, which may require decades to develop. Lung cancer is a special risk to those who smoke cigarettes regularly in addition to having asbestos exposure. Rare mesotheliomas of the pleura and peritoneum (lining around the lungs or abdominal cavity) and possibly cancers of the GI tract and larynx (also smoking related) have been associated with inhalation exposure to asbestos particles. (Crocidolite asbestos has been suggested as the major mesothelioma risk.)</p> <p>In groups of workers exposed to asbestos, lung cancer death is 3 or 4 times more common than mesothelioma death, and 97.5% of asbestos-related lung cancers occur with those workers who also smoke cigarettes! For non-smokers asbestos exposure increases risk of lung cancer 5X.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Notify safety personnel of spills! Exclude all from spill area except trained clean-up personnel who have approved respiratory protection against dust. Provide exhaust ventilation with capture filtration, but do not stir up the dust. Use a wet method or an approved vacuum cleaning system to pick up spills. The techniques used must collect particulate without dispersing dust into the air. Waste must be placed in dust-tight containers or sealed plastic bags for disposal. Label properly!</p> <p><u>DISPOSAL:</u> Deposit waste containers in a secured landfill where asbestos will remain buried. Follow Federal, State and local regulations. Also note that chrysotile can be converted into non-asbestos waste by heating at high temperature (see Sect. V).</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide exhaust ventilation and capture filtration to remove airborne asbestos particulate from the workplace (as much as possible) without dispersing it into the environment. Isolate work areas (also post signs) where asbestos particulate may occur at excessive levels.</p> <p>For nonroutine or emergency conditions where excessive dust is present, approved respirators must be used: Single use or re-usable air-purifying respiratory up to 10X TLV; full-facepiece powered air-purifying respirator up to 100X TLV; full-facepiece air-supplied (continuous flow or pressure-demand type) respirator above 100X TLV.</p> <p>Depending on exposure levels, it may be necessary to provide body-covering work clothes, special vacuuming facilities for clothes and suitable laundering or disposal arrangements, change areas with dual lockering facilities, showers before changing to street clothing after work, etc. Be sure workers do not carry asbestos dust home on their clothing or person. Prevent asbestos dust from being carried to rest rooms, to eating areas, to non-asbestos workplaces, etc.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store asbestos in closed containers (dust tight) in a clean, secure area. Protect containers from physical damage. Do not open containers that can release asbestos dust without providing proper enclosure or control measures. Use dust suppression control measures at all stages of asbestos handling, use and disposal. Follow good housekeeping practices to prevent accumulations of asbestos-containing dust. Avoid inhalation of asbestos. The effects on cancer incidence of chronic exposure are not yet fully known. Monitor areas where asbestos dust is present to be sure of worker exposure levels; keep records to define exposures and retain for at least 20 years. Provide preplacement and annual medical examinations for those exposed in the workplace to 8-hr TWA of 0.1 asbestos fibers or more/cc which are >5 um in length. Retain medical records for at least 20 years.</p>	
<p>DATA SOURCE(S) CODE: 4 6 12 14 20 26 32</p> <p><small>Genium Publishing Corporation assumes no responsibility for the accuracy or completeness of the information contained herein. The user assumes full responsibility for the accuracy or completeness of the information contained herein.</small></p>	<p>APPROVALS: MIS, <i>J. M. J.</i> CRD</p> <p>Industrial Hygiene/ and Safety</p> <p>MEDICAL REVIEW: 12/79</p>

MATERIAL SAFETY DATA SHEET

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No. 44A

HYDROGEN PEROXIDE
(≥ 60%)

Date December 1978

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: HYDROGEN PEROXIDE (≥ 60%)

OTHER DESIGNATIONS: H₂O₂ Concentrated Solution, CAS# 007 722 841

MANUFACTURER: Material is available from several suppliers, including FMC Corporation and Pennwalt Corporation.

SECTION II. INGREDIENTS AND HAZARDS

Hydrogen Peroxide (H₂O₂)

> 60

8-hr TWA 1 ppm*

Water

< 40

--

Proprietary Stabilizer

Small
amount

(such as acetanilide, sodium stannate or other)

*Current OSHA and ACGIH (1978) TLV. Material increases in hazards as H₂O₂ concentration increases. Obtain detailed supplier recommendations, especially for 90% H₂O₂ grade and higher concentrations.

Rat, inhalation
LCLo 100 ppm
(pulmonary edema)

SECTION III. PHYSICAL DATA

	70%	90%	98%	100%
Boiling point at 1 atm, deg C	126	141	148	152.2
Vapor pressure at 30 C, mm Hg	10.1	4.7	3.1	ca 3
Partial pressure of H ₂ O ₂ at 30 C; mm Hg	1.17	2.25	2.67	--
Specific gravity (20/4 C)	1.29	1.39	1.44	1.45
Approx. freezing point, deg C	-40	-11	-2	-0.4
Volumes oxygen produced/1 volume H ₂ O ₂ soln.	300	418	470	--
Water solubility	MISCIBLE			

Appearance & Odor: A clear, colorless to light blue, water-like liquid without odor (or with a characteristic slightly acidic odor).

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	LOWER	UPPER
None	None	None		

Extinguishing Media: Use water in large amounts to fight fire in which this material is involved; other extinguishing agents are expected to be ineffective. Hydrogen peroxide is non-flammable, but it provides oxygen to facilitate or initiate burning of surrounding combustibles. It is a dangerous fire and explosion hazard in a fire situation. When highly concentrated material is heated, shocked by impact, or contaminated it can rupture containers, start fires (with combustibles), or explode. Use large amounts of water to dilute spilled material and flush it away from combustibles. Firefighters must use self-contained breathing equipment and have eye protection.

SECTION V. REACTIVITY DATA

When handled properly and kept cool and pure, this material is stable. It does not polymerize but can decompose releasing heat and oxygen. Above 65% H₂O₂ more heat is released by decomposition than can be absorbed by evaporation of the water present. Unchecked, the decomposition temperature of 70% H₂O₂ can reach to about 500 F, and 90% to 1364 F. Combustibles in contact with this material can be expected to undergo spontaneous ignition, often delayed. A homogeneous mixture with organic materials such as alcohols or glycerine is a sensitive and powerful explosive. Pure H₂O₂ at 90% in water not readily detonated at room temperature, but higher concentrations and/or heat can facilitate detonation. Contamination with certain materials such as iron, chromium, brass, bronze, lead, silver, manganese or their salts or with alkalis or ordinary dirt or rust can give violent decomposition.

NO. 44A

SECTION VI. HEALTH HAZARD INFORMATION	TLV 1 ppm (See Sect. II)						
<p>The health hazard associated with normal usage is acute local damage by oxidation effects on tissue in contact with liquid or vapor, especially of the eyes, skin, and upper respiratory systems. Concentrations in air above 75 ppm are too irritating to be tolerated. Short exposure to very high airborne concentration can be lethal from damage to the respiratory system. The effects of contact with tissues can range from irritation or blistering to necrosis, depending on conditions. Do not ingest! FIRST AID:</p> <p>Eye contact: Immediately flush with plenty of running water for 15 minutes, including under eyelids; then get prompt medical attention.</p> <p>Skin contact: Remove contaminated clothing under a safety shower. Wash affected skin area thoroughly with water. Contact a physician if redness or skin burn is apparent. (Immerse contaminated clothing in water; launder before allowing to dry out.)</p> <p>Inhalation: Remove to fresh air. Contact a physician immediately.</p> <p>Ingestion: Immediately give much water to drink to dilute; encourage vomiting. Give lukewarm water freely and encourage belching if there is evidence of distention. Contact physician.</p>							
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES							
<p>Prepare in advance for emergency situations! A source plenty of water for dilution and flushing of spills must be readily available as well as drainage and a holding area free from incompatible chemicals.</p> <p>Safety personnel should be given prompt notification of significant spills.</p> <p>Immediately flush spills with copious amounts of water, flush away from combustible materials. Provide maximum ventilation; eliminate sources of ignition; evacuate area except for clean-up personnel, who must use full protective equipment (see Sect. VIII).</p> <p>Flush to holding area for dilution with more water and/or the decomposition of H_2O_2.</p> <p>DISPOSAL: Follow Federal, State and local regulations for disposal. Small spills can be highly diluted with water and flushed to the drain.</p>							
SECTION VIII. SPECIAL PROTECTION INFORMATION							
<p>Provide general ventilation and local exhaust ventilation to meet TLV requirements. Local exhaust ventilation and/or hoods should be used where mist or vapors may be generated. Self-contained breathing apparatus must be available for emergency use.</p> <p>Prevent contact with the skin by the use (as required) of boots, protective clothing, and gloves which are impermeable to, and insoluble in, H_2O_2 (polyesters which are antistatic treated, chloroprene, PVC or polyethylene have been recommended).</p> <p>Chemical safety goggles and/or face shield must be used for eye protection. An eyewash station and safety shower must be readily available near use or storage area.</p> <p>Provide special training to employees working with H_2O_2 on body protection, emergency procedures and first aid.</p>							
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS							
<p>Store in original containers (or in an approved container of compatible material) in a cool, clean, fire resistant area away from combustible materials, catalytic metals and compounds, direct sunlight, and sources of heat. A source of ample water must be available for handling spills. Protect containers from physical damage and from contamination. Do not return material to storage container after removal! Ventilation must be good. Containers must be covered and vented. Workers handling H_2O_2 must be specially trained for the assignment. Procedures must maintain the high purity of stored material. Prevent contact with combustible materials. All equipment used to handle hydrogen peroxide must be of approved composition and properly cleaned and passivated before use.</p>							
<p>DOT Classification - OXIDIZER (yellow label)</p> <p>DATA SOURCE(S) CODE: 1,2,4-9, 12,16,20</p> <p><small>Liability is to the user of information herein for purchaser's purposes and necessary disclaimer responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation makes no warranties, express or implied, and assumes no responsibility as to the accuracy or quality of such information or application to particular purposes or for consequences of its use.</small></p>	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="padding: 5px;">APPROVALS: MIS, CRD</td> <td style="padding: 5px; text-align: right;"><i>J. M. Wilson</i></td> </tr> <tr> <td style="padding: 5px;">Industrial Hygiene and Safety</td> <td style="padding: 5px; text-align: right;"><i>[Signature]</i></td> </tr> <tr> <td style="padding: 5px;">Corporate Medical Staff</td> <td style="padding: 5px; text-align: right;"><i>George F. Martin MD</i></td> </tr> </table>	APPROVALS: MIS, CRD	<i>J. M. Wilson</i>	Industrial Hygiene and Safety	<i>[Signature]</i>	Corporate Medical Staff	<i>George F. Martin MD</i>
APPROVALS: MIS, CRD	<i>J. M. Wilson</i>						
Industrial Hygiene and Safety	<i>[Signature]</i>						
Corporate Medical Staff	<i>George F. Martin MD</i>						

APPENDIX B
RESPIRATORY PROTECTION PROGRAM



SUBJECT:

RESPIRATORY PROTECTION --
EXCEPT SCBA

NUMBER

13

PAGE

1 of 6

DATE FIRST
PUBLISHED

5/89

1. POLICY

No individual will enter an area where respiratory protective equipment is required unless the person has been trained in the selection, use, care and limitations of the respirator, and the proper respirator has been selected for the task.

2. PURPOSE

This procedure provides project managers and employees with requirements in the selection, use, care, and limitations of respiratory protective equipment.

3. SCOPE

This procedure applies to all types of respiratory protective equipment except SCBA.

4. GENERAL REQUIREMENTS

- 4.1 Whenever respirators are required, only equipment approved for that purpose will be used. This equipment must be approved by the Mine Safety and Health Administration (MSHA) and the National Institute for Occupational Safety and Health (NIOSH). Only parts approved for the specific respirator system are to be used for replacement. Modifications to respirators are not allowed unless authorized by the approved agency. Only a person specifically trained should perform work on respirators.
- 4.2 Proper selection of respirators is to be made according to guidance provided by ANSI standard Z88.2 -1980. The correct respirator is to be specified for each job. Site health and safety plans, as part of the level of protection requirements, will specify the type of respirator to be used.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: RESPIRATORY PROTECTION -- EXCEPT SCBA	NUMBER	13
	PAGE	2 of 6
	DATE FIRST PUBLISHED	5/89

The hazardous site is also constantly monitored to indicate any changes in the working conditions. This procedure allows site safety officers to choose the correct type of respirator in any given situation. OHM site safety officers periodically monitor the level of contamination in the work area. They determine the amount of exposure the employees face and the acceptable level for each employee. Direct reading instruments are used to make sure the proper respirator is selected.

- 4.3 Any employee issued a respirator will be provided training in the selection, use, care, and limitations of the respirator, including the provisions of this procedure. Additionally, anyone using a negative pressure respirator will receive a fit test at least annually. The fit test will be qualitative, although for certain projects, a quantitative fit test will be required as designated by the site safety plan.

After the respirator fitting test has been completed, employees will be issued and must keep a record of the test results. The following information must be recorded: the type of test administered, type of respirator used, name of employee tested, name of employee giving the test, date, and test results.

- 4.4 Respirators are to be inspected by the user before each use and not worn if defective or if conditions prevent a gas tight face to face piece seal. Each part of the respirator must be examined. Check for cuts, holes stiffening, or crushing of the facepiece. The headbands must not have any breaks, tears, bent or missing hardware, or loss of elasticity. The inhalation and exhalation valve system must be checked for dust or dirt on valve flap. No tears or cracks may exist in the valve itself.

**OHM****HEALTH AND SAFETY PROCEDURES**

NUMBER

13

PAGE


3 of 6

DATE FIRST
PUBLISHED

5/89

SUBJECT: RESPIRATORY PROTECTION --
 EXCEPT SCBA

- 4.5 Employees may not wear facial hair that interferes with a good gas tight face seal. Other conditions which could interfere with a good face seal include wearing of glasses under full-face respirators, absent teeth or dentures, or unusual face configurations.
- 4.6 Contact lenses are not to be worn in an atmosphere requiring a respirator. Eyeglass kits for prescription lenses in a full-face respirator will be provided by OHM.
- 4.7 All breathing air used for supplied air respirators must be grade D or better as described by the Compressed Gas Association Specification G-7.1-1973. The breathing air supply must be equipped with necessary safety items including alarms to indicate low air pressure. If an oil lubricated compressor is used, an additional alarm to indicate over temperature or carbon monoxide buildup must be used. Air line couplings associated with breathing air must be incompatible with outlets for other gas systems.
- 4.8 Persons will not be assigned tasks requiring the use of respirators unless it has been determined that they are physically able to perform the work while using the respiratory equipment. A physician with sufficient knowledge of respiratory protection will determine what health and physical conditions are pertinent. The medical status of persons assigned to use respirators will be reviewed annually.
- 4.9 Respiratory equipment will be cleaned, inspected, and sanitized after each use by the user or site person assigned to decontamination. When not in use, respirators are to be stored to protect against dust, sunlight, extreme temperatures, excessive moisture, or damaging chemicals.

 OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: RESPIRATORY PROTECTION -- EXCEPT SCBA	NUMBER	13
	PAGE	4 of 6
	DATE FIRST PUBLISHED	5/89

4.10 Cleaning will be accomplished in four steps:

4.10.1 Washing

The respirator should be washed in warm water about 140 degrees Fahrenheit with a good detergent using a soft brush. Insert all valves and headband.

4.10.2 Rinsing

4.10.3 Disinfecting

Disinfecting rinse consisting of two table-spoons chlorine bleach added to a gallon of water.

4.10.4 Rinsing

After disinfecting, the respirator will be rinsed in clean, warm water. All traces of detergent and disinfectant must be removed.

4.10.5 Drying

Allow respirator to air dry by hanging or placing on a clean surface. If not possible to air dry, then towel dry before bagging. When dry, assemble the respirator, and store in a clean polybag.

4.11 An evaluation of the respiratory protection program's effectiveness should take place at least once a year. Improvements and modifications correct any program deficiencies or meet additional needs should be accomplished. The program evaluation considers wearer acceptance of the respirator, additional inspection of the program in action, and appraisal of the protection provided to employees.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: RESPIRATORY PROTECTION -- EXCEPT SCBA	NUMBER	13
	PAGE	5 of 6
	DATE FIRST PUBLISHED	5/89

5. SPECIFIC RESPIRATORS

5.1 Air Purifying -- General Information

Air purifying respirators provide clean air to the wearer by passing atmosphere air through a filtering element. Because most air purifying respirators are also negative pressure (the driving force for air movement is the users inhalation, creating a negative pressure inside the mask), any leakage around the sealing surface of the respirator will be directed inward. Thus air purifying respirators offer a lower level of protection than air supplied respirators. Air purifying respirators are never to be worn in oxygen deficient atmospheres (less than 20.8 percent oxygen). Air purifying respirators are not to be worn when the airborne contaminant does not possess adequate warning properties (i.e., odor) to warn the user of cartridge breakthrough. Air purifying respirators may be either a half-facepiece or full-facepiece style.

5.2 Air Purifying -- Cartridge Type

A variety of cartridges exist for air purifying respirators. The specific one used depends on the type of contaminant being protected against. The site health and safety plan will specify which cartridge is to be used. Common cartridges available include organic vapors, acid gases, ammonia, and various combinations of the above. Furthermore, particulates can be filtered as well, often in combination with gas and vapor protection. Some materials require use of a High Efficiency Particulate Aerosol (HEPA) filter.

5.3 Disposable Air Purifying Respirators

Disposable (paper) respirators do not protect against gases or vapors. Due to the uncertainty involved in fitting a paper mask, these respirators are not to be used except for nuisance-type dusts.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: RESPIRATORY PROTECTION -- EXCEPT SCBA	NUMBER	13
	PAGE	6 of 6
	DATE FIRST PUBLISHED	5/89

5.4 Air Supplied Respirators -- SCBA

A SCBA provides the highest level of protection of any respirator. SCBAs are addressed in greater detail in a separate Health and Safety Procedure.

5.5 Air Supplied Respirators -- Airline Respirators with
Escape Pack

In some cases, an airline respirator with an emergency escape pack may be used instead of an SCBA. This unit consists of a pressure demand airline respirator connected to a source of breathing air combined with a 5-minute air bottle unit to allow escape if the source of breathing air fails.

5.6 Airline respirators in the continuous flow mode are not approved for Immediately Dangerous to Life and Health (IDLH) or oxygen deficient atmospheres. However, they do provide a higher level of protection than air purifying respirators because facepiece leakage tends to be outward. Prior to use, alarms and any air filters must be checked. Supplied air must be grade D or better. Hose length must be limited to 250 feet for Survivair, but it is recommended that 50 feet be the maximum hose length. The airline hose may constitute a safety problem if activities such as ladder climbing are required.

OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: SELF-CONTAINED BREATHING APPARATUS (SCBA)	NUMBER	14
	PAGE	1 of 3
	DATE FIRST PUBLISHED	5/89

1. POLICY

A Self-Contained Breathing Apparatus (SCBA) is approved for IDLH or oxygen deficient (less than 20.8 percent) situations.

2. PURPOSE

This procedure provides project managers and employees with the requirements in the use, care, and limitations of SCBAs.

3. SCOPE

This procedure applies only to use of SCBAs.

4. PROCEDURE


4.1 SCBAs are to be used whenever level A or B protection is required whenever the site health and safety officer requires their use or whenever the hazards of a situation cannot be assessed prior to entry.

4.1.1 Exceptions based upon site conditions may be granted where an airline respirator with escape pack system has been approved by the site safety officer.

4.2 Only SCBAs operating in the positive pressure (pressure demand) mode will be used.

4.3 No individual will use an SCBA until training on the use, care and limitations of the SCBA has been received. Such training will be received at least annually.

4.4 SCBAs are to be inspected by the user prior to use to ensure the cylinder is fully charged, the regulator and warning devices operate properly, and that the harness, facepiece, hoses, and head straps are in good condition.


OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT.	SELF-CONTAINED BREATHING APPARATUS (SCBA)	NUMBER	14
		PAGE	2 of 3
		DATE FIRST PUBLISHED	5/89

- 4.5 SCBAs are not to be used if the tank is not fully charged or if any other condition exists which could cause failure of the unit during use.
- 4.6 When using an SCBA, users will leave the work area promptly when the low air pressure alarm signal sounds.
- 4.7 Individuals are not to make repairs or modifications to an SCBA unless specifically authorized by the manufacturer of the unit and the site safety officer.
- 4.8 The site safety officer is responsible for maintaining the SCBAs ready for use at all times. This includes performing the monthly inspections and inspecting, sanitizing, and refilling or replacing the air tanks after each use.
- 4.9 Monthly inspections are to include checks on tightness of connections and the condition of the headbands, valves, and connecting tubes. Rubber parts are to be inspected for pliability and deterioration. The air tank must be fully charged and the hydrotest certification must be correct. Regulator and warning devices must function properly. A record of inspection dates is to be maintained on the SCBA or in its storage container and must include the inspector's name, date of inspection, and identification number of the SCBA. The inspection checklists are to be kept with the SCBA for reference. The checklist is shown following this procedure.
- 4.10 Any deficiency noted during inspection requires removing the SCBA from service until the condition is corrected. The SCBA and the storage case must be clearly marked or tagged OUT OF SERVICE.
- 4.11 SCBAs are not to be worn if conditions prevent a gas tight face to facepiece seal. Employees may not wear facial hair that interferes with a gas tight face

 OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: SELF-CONTAINED BREATHING APPARATUS (SCBA)	NUMBER	14
	PAGE	3 of 3
	DATE FIRST PUBLISHED	5/89

seal. Other conditions which could interfere with a face seal include wearing of glasses, absent teeth or dentures or unusual face configurations.

- 4.12 Contact lenses are not to be worn in an atmosphere requiring an SCBA. Eyeglass kits for prescription lenses are provided by OHM.
- 4.13 Persons will not be assigned tasks requiring the use of an SCBA unless it has been determined that they are physically able to perform the work while wearing the SCBA. A physician with sufficient knowledge of respiratory protection will determine what health and physical conditions are pertinent. The medical status of persons assigned to use SCBAs will be reviewed annually.

APPENDIX C

OHM SELECTED SAFETY PROCEDURES

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: CONFINED SPACE ENTRY	NUMBER	18
	PAGE	1 of 4
	DATE FIRST PUBLISHED	5/89

1. POLICY

No employee is to enter a confined space until atmospheric testing has been conducted and a confined space entry permit has been completed. Confined space permits are valid for a single work shift only.

2. PURPOSE

This procedure provides personnel with requirements for working safely in confined spaces.

3. DEFINITIONS

- 3.1 Confined Space -- Any enclosed area having a limited means of egress where ventilation is not adequate to remove a toxic or flammable atmosphere or oxygen deficiency which may exist. Examples of confined spaces include, but are not limited to: tanks, vessels, bins, boilers, ducts, skewers, underground utility vaults, manholes, tunnels, pipelines, or any open top space more than four feet in depth such as pits, tubes, vaults, or vessels.
- 3.2 Oxygen Deficiency - Atmospheres which contain less than 19.5 percent oxygen.
- 3.3 Flammable Atmosphere - Atmospheres in excess of 10 percent of the lower flammable limit of the material in question. These are often toxic as well as flammable.
- 3.4 Toxic Atmosphere - Atmospheres having concentrations of airborne chemicals in excess of permissible exposure limits as defined by federal or state regulations or Threshold Limit Values (TLVs).

OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONFINED SPACE ENTRY

NUMBER

18

PAGE

2 of 4

DATE FIRST
PUBLISHED

5/89

4. PROCEDURE

- 4.1 A confined space entry permit containing the applicable elements of this section will be written and approved prior to any entry into a confined space.
- 4.2 The confined space is to be emptied, flushed, or otherwise purged of hazardous substances.
- 4.3 Pipes or lines which convey any kind of substance to the confined space are to be disconnected, blinded, or have the valve locked off to prevent such substances from entering the confined space while work is in progress.
- 4.4 Electrical circuits to fixed mechanical equipment which may cause injury if accidentally energized must be de-energized and locked out.
- 4.5 The air in the confined space is to be tested for oxygen deficiency, flammable atmosphere, and any toxic contaminants likely to be present. All tests of the atmosphere are to be made by trained, competent personnel using calibrated equipment.
- 4.6 Electrical equipment and lighting are to be explosion proof when used in confined spaces subject to flammable or explosive gases, vapors, or dusts. Extreme care must be taken in dusty atmospheres because there may be no indication of problems on atmospheric test equipment, yet a hazard exists. Power tools should be pneumatic when possible.
- 4.7 All work will stop and the confined space evacuated if any indication of ill effect such as dizziness, irritation, or excessive odors are noted.
- 4.8 Welding and/or cutting in a confined space shall require the use of a hot-work permit. Cutting gas cylinders and welding machines will not be taken into confined spaces.

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: CONFINED SPACE ENTRY	NUMBER	18
	PAGE	3 of 4
	DATE FIRST PUBLISHED	5/89

- 4.9 All employees entering a confined space shall wear an approved safety harness. When the confined space is entered through a manhole or is deeper than the employee's shoulders, an approved life line should be attached. When the nature of the space entered involves more than one employee and the fouling of life lines could occur, the Safety Department should be consulted.
- 4.10 Rescue equipment must be at the project site prior to commencing work. Rescue equipment will include extra rope, safety harnesses, stretchers, and emergency SCBA. No one should enter a confined space until adequate safety equipment is present to remove an unconscious person.
- 4.11 A ladder is required in all confined spaces deeper than the employees' shoulders. The ladder shall be secured and not removed until all employees have exited the space.
- 4.12 The project supervisor is responsible for evaluating general safety hazards including permits, locking out of equipment, adequate lighting, tools, etc. and is responsible for assuring the confined space entry permit is completed.
- 4.13 Confined space entry permits will be maintained in the project file.
- 4.14 A copy of the confined space entry permit follows this procedure.

5. CONFINED SPACE ENTRY PROCEDURES FOR SAFETY OBSERVER

Employees entering a confined space must be under the constant surveillance of a safety observer. It is the safety observer's responsibility to follow this procedure:

- o A valid confined-space entry permit must be at the site.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONFINED SPACE ENTRY	NUMBER	18
	PAGE	4 of 4
	DATE FIRST PUBLISHED	5/89

- o Rescue equipment must be available at the site.
- o The safety observer must know the location of the nearest telephone and emergency numbers, safety shower, and fire extinguishers.
- o When welding or cutting is done in a confined space, the safety observer must know how to shut down the equipment.
- o The safety observer must remain in constant contact with the employees in the confined space. The observer is not to leave his/her assigned station space except to report an emergency.

**OHM****CONFINED SPACE ENTRY PERMIT**

C-5

Permit No. _____

Good on this Date Only: _____ From: _____ a.m. p.m. To: _____ a.m. p.m.

Location: _____ Project No. _____

Workers Authorized Entry:

Work Monitors:

Work Monitors:

_____	_____	_____
_____	_____	_____
_____	_____	_____

Description of Job or Special Procedures: _____
_____**Employee Training and Pre-Entry Briefing**

1. Safe Entry and Rescue Training Conducted on: _____ (Date)
2. Mandatory Pre-Entry Briefing Conducted on: _____ (Date)
3. Does this Job Require Special Training? Yes ☐ No ☐

Contractor Notification

Contractor Notified of: Permit Conditions _____ Potential Hazards _____ N/A _____

Lighting Requirements

Special Tools/Equipment

Communication Devices

_____	_____	_____
_____	_____	_____
_____	_____	_____

1. Are All Electrical Devices Intrinsically Safe? Yes ☐ No ☐
2. Have All Power Cords and Tools Been Visually Inspected? Yes ☐ No ☐

Vessel Preparation

- | | | |
|--|------------------------------|-----------------------------|
| 1. Work Area Isolated with Signs/Barriers? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 2. All Energy Sources Locked/Tagged Out? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 3. All Inlet Lines Capped/Blinded? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 4. Vessel Contents Drained/Flushed/Neutralized? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 5. Vessel Cleaned/Purged? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |
| 6. Ventilation Provided 30 Minutes Before Entry? | Yes <input type="checkbox"/> | No <input type="checkbox"/> |

Pre-Entry Atmospheric Testing

1. Test for Oxygen Content:	Reading: _____ % O ₂	Time: _____	Initials: _____
2. Test for Flammable Concentration:	_____ % LEL	_____	_____
3. Test for Toxic Concentration:	_____ ppm of _____ (TLV= _____)	_____	_____
4. Test for Heat Stress Hazard:	_____ °F _____ °C _____ WBGT	_____	_____

Emergency/Rescue Procedures

1. Location of Written Emergency/Rescue Plan: _____
2. Type of Emergency/Rescue Team Required: On-Site _____ Off-Site _____ Phone No. _____

Safety Equipment

Personal Protective Equipment Required:

Area Safety Equipment Required:

1. Self-Contained Breathing Apparatus Required? Yes ☐ No ☐
2. Portable Atmospheric Monitor Required? Yes ☐ No ☐

Type: _____
Type: _____**Permit Authorization**

I certify that I have inspected the work area for safety and reviewed all safety precautions recorded on this permit.



HEALTH AND SAFETY PROCEDURES

SUBJECT: LINE ENTRY	NUMBER
	19
	PAGE
	1 of 4
	DATE FIRST PUBLISHED
	5/89

1. POLICY

No employee is to break into a line until a line entry permit has been completed. The line entry permit is valid for a single work shift only.

2. PURPOSE

This procedure provides requirements for breaking into lines which contain or may contain hazardous materials.

3. PROCEDURE -- PRE-ENTRY

- 3.1 Prior to beginning operations at a site, the potential hazards associated with line entry will be recognized and addressed.
- 3.2 Each line should be regarded as potentially full and pressurized with a toxic, flammable product until it is proven otherwise. Safe line entry requires investigation and pre-planning before work begins.
- 3.3 It is critical to determine the line contents in order to assess the products' toxic and flammable properties.
 - o Trace line to each end. For example, identify the pipe run between tanks or reactors.
 - o Check for color coding. Many plants designate line contents by their own color-coding system. Do not assume one plant's code is the same as another or consistent within each plant.
 - o If necessary, sample line contents.
- 3.4 Scaffolding or manlifts used for elevated piping must be used according to manufacturer's specifications. Guardrails and tieoffs must be used.



HEALTH AND SAFETY PROCEDURES

SUBJECT: LINE ENTRY	NUMBER	19
	PAGE	2 of 4
	DATE FIRST PUBLISHED	5/89

- 3.5 Portable lighting must be provided if area is not sufficiently illuminated.
- 3.6 Any electrical lines near the work area must be de-energized prior to beginning operations. All electrical circuits are to be locked out.
- 3.7 Establish the level of protection (personal protective equipment) needed for the job, as well as any decontamination, secondary containment or spill response procedures.

4. PROCEDURE -- LINE BREAKING

- 4.1 Isolate the line by closing, locking, and tagging all valves entering the line.
- 4.2 Lock and tag all electrical systems for pumps and automatic valves contained in the pipe run to be entered.
- 4.3 Remove all free product by pumping or draining. Inert or purge if applicable.
- 4.4 Blank or Disconnect Line -- Install some physical barrier to prevent additional product from entering the system.
 - 4.4.1 Insert a blank or blind in a line to block it completely. This is important since valves should not be considered trustworthy. Valves have been known to leak even when fully closed.
 - 4.4.2 Make use of double block and bleed (two closed valves within close proximity of each other with an open drain line between), if available.



HEALTH AND SAFETY PROCEDURES

SUBJECT: LINE ENTRY	NUMBER
	19
	PAGE
	3 of 4
	DATE FIRST PUBLISHED
	5/89

4.5 Prepare for Line Entry

- 4.5.1 Establish exclusion zone. Zone should be sufficiently large to prevent unprepared people from contacting line material from liquid splash or vapor/gas emission.
- 4.5.2 Stage appropriate spill-control media at site.
- 4.5.3 Establish fire watch if necessary.
- 4.5.4 Review level of personal protective equipment (i.e., respirator, clothing, gloves, and eye protection).
- 4.5.5 Conduct air monitoring, including perimeter monitoring, for possible releases and explosive atmosphere survey or work area.
- 4.5.6 Stage appropriate working surface (i.e., ladder, scaffold, manlift, etc.)

4.6 Enter the Line

- 4.6.1 Best place to enter a line is at a flange.
- 4.6.2 Use nonsparking tools, such as brass, to loosen flange bolts if dealing with a flammable material.
- 4.6.3 Slowly loosen top flange bolts first. If pressurized, this will relieve it. If the line still contains fluid, the material will be noted as dripping or welling around the flange. If these conditions are noted, retighten and recheck purge procedures.
- 4.6.4 Because of possible leaks, no one will stand adjacent to or under a flange when opening.

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: LINE ENTRY	NUMBER	19
	PAGE	4 of 4
	DATE FIRST PUBLISHED	5/89

- 4.7 The project supervisor is responsible for evaluating all safety hazards and assuring that the line entry permit is properly completed.
- 4.8 Line entry permits will be maintained in the project file.
- 4.9 A copy of the line entry permit follows this procedure.



LINE BREAKING PERMIT
(Good for One Work Shift Only)

A) Date _____ Time _____^{a.m.}/_{p.m.} To _____^{a.m.}/_{p.m.}
 Location _____
 Line of Equipment _____

 Potential Chemical Hazards _____

B) Safety Precautions

- | | | |
|---|-----------|---------------------|
| 1) All emergency equipment in position? (Eyewash and safety shower, sorbent material, fire extinguishers, etc.) | Yes _____ | No _____ |
| 2) Lines drained, purged and/or washed clean of material? | Yes _____ | Not Necessary _____ |
| 3) All valves checked for positioning and tagged? | Yes _____ | Not Necessary _____ |
| 4) All electrical equipment locked out and tagged? | Yes _____ | Not Necessary _____ |
| 5) Fire watch designated? | Yes _____ | Not Necessary _____ |
| 6) Excursion zone roped off and signs posted? | Yes _____ | Not Necessary _____ |
| 7) Personnel wearing adequate personal protective equipment for expected hazard (consult site safety plan)? | Yes _____ | Not Necessary _____ |
| 6) LEL survey completed? | Yes _____ | Not Necessary _____ |
| 9) Air monitoring equipment for poisonous/toxic substance available? | Yes _____ | Not Necessary _____ |
| 10) Decontamination, spill response equipment and procedures established, in place, and ready for response? | Yes _____ | Not Necessary _____ |
| 11) All personnel briefed on procedures? | Yes _____ | Not Necessary _____ |

I Certify that all necessary precautions have been taken in accordance to the line breaking procedures.

Supervisor _____

Forman _____

Site-Safety Officer _____

Line Breaking Crew _____

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: HOT WORK

NUMBER

20

PAGE

1 of 6

DATE FIRST
PUBLISHED

5/89

1. POLICY

No work involving a flame or spark producing operations is to be conducted without preparing a hot work permit and following the provisions of this procedure.

2. PURPOSE

This procedure establishes requirements for cutting or burning operations.

3. REQUIREMENTS

3.1 The site safety officer is to issue the hot work permit for any flame- or spark-producing operation. This procedure is to be conducted daily whenever such operations occur.

3.2 This procedure is to be read and complied with by any employee conducting hot work.

3.3 The OHM site supervisor or site safety officer will complete the following procedures prior to beginning hot work:

3.3.1 Conduct a visual inspection of area. Remove any combustible material surrounding the work area. Special attention will be paid to areas where hot slag can fall or spatter. Any combustible material which cannot be readily removed will be covered or otherwise protected from the hot materials. For example, covering a combustible surface with one inch of soil or wetting it may be sufficient.

3.3.2 Designate a fire watch. This person's (or persons') sole responsibility will be to monitor the welding or burning operation and have immediate access to a fire extinguisher of sufficient size and type for the potential combust-

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: HOT WORK	NUMBER	20
	PAGE	2 of 6
	DATE FIRST PUBLISHED	5/89

ible material. In addition, this person(s) shall be trained in the proper use of the appropriate fire extinguisher and be knowledgeable of the emergency signal and evacuation procedures as well as emergency shutdown procedures.

3.3.3 Do not begin until all spaces, pipes, and sumps have been opened and tested for the presence of flammables. If any flammable or combustible vapors exceed 10 percent lower explosive limits (LEL), no work will begin until levels are reduced. As a rule, no hot work will begin when any combustible vapor is present.

3.3.4 Personnel working in the area of the hot work will be alerted to the fact that hot work is taking place.

3.3.5 A hot-work permit will be completed and posted

4. BURNING OPERATION SAFETY RULES

- 4.1 Wear adequate flame and heat resistant apparel and appropriate eye protection. This includes chipping operations.
- 4.2 Ensure that the area below is roped off and posted if work is overhead.
- 4.3 Protect personnel and equipment in near vicinity against exposure from arc or sparks.
- 4.4 Observe good housekeeping practices; keep excess hoses, cables, and equipment out of aisle ways, stairways, and your work station.
- 4.5 Never use oil, grease, or pipe fitting compounds to make up connections on oxy-acetylene welding equipment.

**OHM**

HEALTH AND SAFETY PROCEDURES

SUBJECT: HOT WORK	NUMBER	20
	PAGE	3 of 6
	DATE FIRST PUBLISHED	5/89

- 4.6 Store fittings in a manner to prevent contamination.
- 4.7 Do not interchange oxygen and acetylene hoses; oxygen is coded green and acetylene is coded red.
- 4.8 Do not force connections or strike or force valve wheels.
 - 4.8.1 Before connecting cylinders, read the label to ensure that the proper gas is being used.
 - 4.8.2 Cylinders must not be placed where they might form part of an electrical circuit. Keep cylinders away from grating, layout tables and piping systems that may be used for ground of electrical welding circuits.
- 4.9 Open oxygen valves momentarily to remove dust or dirt; stand on one side of the valve and avoid contact of gas with any combustible material.
 - 4.9.1 Pressure-adjusting screws on regulators will be fully released before the regulator is attached to a cylinder and the cylinder valve opened. Open the cylinder valves slowly; stand to one side, not in front of pressure regulator gauge faces when opening cylinder valves.
 - 4.9.2 Do not use adjustable wrenches on acetylene cylinders; use the T-wrench provided. Keep it in place at the cylinder.
 - 4.9.3 Never open an acetylene cylinder valve more than one and one half turns.
- 4.10 Do not store tools or equipment in the recessed top of an acetylene cylinder, and do not allow water to accumulate there.
- 4.11 Inspect the welding hose for defects before each use. Keep hoses clear of equipment and hot slag.

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: HOT WORK	NUMBER	20
	PAGE	4 of 6
	DATE FIRST PUBLISHED	5/89

- 4.12 Do not use oxygen for cleaning, pressurization, or for ventilation.
- 4.13 Do not relight flame on hot work when in an enclosed space. Allow time for gases to escape and then use friction lighter.
- 4.14 A metal part which is suspiciously light probably has a void inside and an opening should be drilled before heating. Electrical boxes at the end of conduit should be opened prior to cutting conduit. Valves on both ends of piping should be opened.
- 4.15 Never lay work that is to be heated or welded on a concrete floor because when sufficiently heated, concrete may spall and fly with danger of injury.
- 4.16 Do not cut material in such a position that severed parts will fall striking legs or feet of the operator or assistant, or damaged gas lines.
- 4.17 When a flashback occurs, both gases should be shut off -- first oxygen, then acetylene. Before lighting the torch again, see that it is cool and that no damage has been done to the torch, hose, or regulator.
- 4.18 Mark work "HOT" if left unattended or where others may come in contact with hot surfaces.
- 4.19 When burning operations are to be stopped for a few minutes during the course of the work, it is permitted to close torch valves only. When work is stopped for a longer period or is left unattended, the following steps must be taken:
- o Close oxygen and acetylene cylinder valves
 - o Open torch valves to relieve pressure, then close again
 - o Release regulator pressure adjusting screws


OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: HOT WORK	NUMBER	20
	PAGE	5 of 6
	DATE FIRST PUBLISHED	5/89

4.20 Before regulator is removed from a cylinder, the cylinder valve will be closed and the gas released from the regulator.

5. PERSONAL PROTECTIVE EQUIPMENT

The normal personal protective equipment worn when working with hazardous materials generally provides inadequate protection from flames or heat. The person performing the work shall supplement the existing equipment with the following:

- o Welding gloves fashioned from leather or other fire-resistant material
- o Apron or jacket fashioned from leather or other fire-resistant material
- o Chapps, if necessary, for leg protection
- o Eye protection and face protection with appropriate ANSI darkened lenses
- o If necessary, flash-fire protection. Note: normal chemical protective clothing is inappropriate for fire situations.

6. HOT WORK PERMIT

6.1 No employee of OHM is to begin hot work unless a hot work permit has been obtained. It is the responsibility of the project supervisor to request this permit. The hot-work permit shall be signed by the supervisor and site safety officer and explained to each affected employee.

- 6.1.1 It is the responsibility of the project supervisor to see that workers comply with all safety practices of the hot work permit.

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: HOT WORK	NUMBER	20
	PAGE	6 of 6
	DATE FIRST PUBLISHED	5/89

- 6.2 The hot work permit will be valid for a single work shift only. On projects requiring more than a single work shift, a new permit shall be completed at the start of each shift. The permit shall be displayed at the project site.
- 6.3 At the conclusion of the project, the hot work permits will be forwarded to the site project control technician and placed in the project file.



HOT WORK PERMIT

Date: _____ Time: _____

Location: _____

Issued to: _____

Site Safety Officer: _____

Supervisor: _____

Do not cut or use other open-flame or spark producing equipment until the following precautions have been taken.

Protective Equipment used _____

(Initial Each Item)

- _____ The location where the work is to be done has been personally examined.
- _____ Any available fire protection systems are in service.
- _____ There are no flammable dusts, vapors, liquids or unpurged tanks (empty) in the area.
- _____ Explosimeter reading <10% LEL
- _____ All combustibles have been moved away from the operation, or otherwise protected with fire curtains or equivalent.
- _____ Ample portable fire extinguishing equipment has been provided.
- _____ Arrangements have been made to patrol the area for at least 1/2 hour after the work has been completed.
- _____ The phone number for the local Fire Department is _____

This form must be filled out daily whenever HOT WORK is being conducted and posted at the jobsite.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONSTRUCTION/DEMOLITION	NUMBER
	32
	PAGE
	1 of 8
	DATE FIRST PUBLISHED
	5/89

1. POLICY

OHM and its contractors will provide a safe workplace for construction/demolition activities in compliance with this procedure, this manual, and all applicable regulations.

2. PURPOSE

This procedure provides fundamental safety rules specifically addressing construction/demolition projects.

3. JOB SAFETY PLANNING

3.1 In preparing the estimate, a realistic sum of money for safety requirements in accordance with conditions, company safety policies, federal and state safety and health regulations, owner, and other regulatory agency specifications is to be included.

3.2 Hold a pre-job planning meeting soon after ~~contract~~ award to discuss:

3.2.1 Owner, company, regulatory agency requirements.

3.2.2 Hazards and control measures involving COMPANY EMPLOYEES, equipment and materials (refer to the federal and state safety and health regulations for specific requirements to include the following topics:

- o Personal protective equipment required.
- o Lighting for night operations.
- o Fire prevention, fire fighting equipment.
- o Ladders, scaffolds, nets, overhead protection and other temporary structure safety requirements.



HEALTH AND SAFETY PROCEDURES

SUBJECT:

CONSTRUCTION/DEMOLITION

NUMBER

32

PAGE

2 of 8

DATE FIRST
PUBLISHED

5/89

- o First aid and medical requirements.
- o Traffic patterns, haul road layout, designated parking areas.
- o Sanitary requirements, drinking water.
- o Security.

Hazards and control measures involving members of the PUBLIC AND/OR THEIR PROPERTY. Address the following:

- o Public vehicular traffic exposure - need for signs, barricades, flashers, flagmen, detours, traffic lights.
- o Public pedestrian and children - need for temporary walkways, overhead protection, watchmen, securing equipment, fencing and other methods of protection and denial of access.
- o Railroad - protection required, notification to railroads of our operation, securing train schedules, flagmen, signs, warning signals, reduced speed, special insurance
- o Utilities - underground and overhead-locating and marking, notification of schedules, special insurance.
- o Use of flashing yellow lights on equipment working in and around traffic.

- 3.2.4 Prepare a site safety plan to be used as a guide in ordering safety documents and in developing the safety program at the start of the job.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONSTRUCTION/DEMOLITION	NUMBER
	32
	PAGE
	3 of 8
	DATE FIRST PUBLISHED
	5/89

3.2.5 Order safety equipment to arrive ahead of need. Spell out safety features desired on new equipment being purchased. Check rented equipment before making agreements to be sure equipment has essential safety features.

3.3 Review Site Safety Plan:

3.3.1 Status of safety equipment ordered.

3.3.2 Any changed conditions and effect on safety requirements.

3.3.3 Notifications to railroads, utility companies.

3.3.4 Contacts with insurance carrier to obtain their recommendations.

3.4 Safety inspection of equipment: correct deficiencies before equipment goes to work. Required safety features must be installed on rented units.

3.5 Review safety program with subcontractors to familiarize them with requirements for safety. Give them a copy of the written program.

4. ORIENTATION OF JOB SITE PERSONNEL

4.1 Each employee is to be instructed in the recognition and avoidance of unsafe conditions and the regulations applicable to his/her work environment to control or eliminate hazards or exposures to illness and injury.

4.2 The following paragraphs describe the methods to be used and records to be maintained in the indoctrination session and tailgate meetings.

**OHM****HEALTH AND SAFETY PROCEDURES**

SUBJECT: CONSTRUCTION/DEMOLITION	NUMBER	32
	PAGE	4 of 8
	DATE FIRST PUBLISHED	5/89

4.2.1 New employees working in non-office environments shall be provided indoctrination as to the company safety program job site rules and safety rules pertaining to their job assignments prior to beginning work. This orientation shall be conducted by personnel knowledgeable in the requirements.

4.2.2 Upon completion of the review of the site safety plan, workers will sign the acknowledgement.

5. PROTECTION OF THE PUBLIC

All necessary precautions shall be taken to prevent injury to the public or damage to property of others. Precautions to be taken shall include, but are not limited to the following:

- 5.1 Work shall not be performed to any area occupied by the public unless specifically permitted by the contract or in writing by the construction manager.
- 5.2 When it is necessary to maintain public use of work areas involving sidewalks, entrances to buildings, lobbies, corridors, aisles, stairways and vehicular roadways, trade contractors shall protect the public with appropriate guardrails, barricades, temporary fences, overhead protection, temporary partitions, shields and adequate visibility.
- 5.3 Sidewalks, entrances to buildings, lobbies, corridors, aisles, doors or exits shall be kept clear of obstructions to permit safe entrance and exit of the public at all times.
- 5.4 Appropriate warnings and instructional safety signs shall be conspicuously posted where necessary. In addition, a signalman shall control the movement of motorized equipment in areas where the public might be endangered.



HEALTH AND SAFETY PROCEDURES

SUBJECT: CONSTRUCTION/DEMOLITION	NUMBER
	32
	PAGE
	5 of 8
	DATE FIRST PUBLISHED
	5/89

5.5 Sidewalks, sheds, canopies, catch platforms and appropriate fences shall be provided when it is necessary to maintain public pedestrian traffic adjacent to the erection, demolition or structural alternation of outside walls on any structure.

5.6 A temporary fence shall be provided around the perimeter of above ground operation adjacent to public areas. Perimeter fences shall be at least six (6) feet high.

They may be constructed of wood or metal frame and sheathing, wire mesh, or a combination of both. When the fence is adjacent to a sidewalk near a street intersection, at least the upper section of fence shall be open wire mesh from a point not over four (4) feet above the sidewalk and extending at least twenty-five (25) feet in both directions from the corner of the fence or as otherwise required by local conditions.

Guardrails shall be provided on both sides of vehicular and pedestrian bridges, ramps, runways, and platforms. Pedestrian walkways elevated above adjoining surfaces, or walkways within six (6) feet of the top of excavated slopes or vertical banks shall be protected with guardrails. Guardrails shall be made of rigid materials capable of withstanding a force of at least two hundred (200) pounds applied in any direction at any point in their structure. Their height shall be approximately forty-two (42) inches. Top rails and posts may be two (2) inches by four (4) inches dressed wood or the equivalent. Intermediate horizontal rails at mid-height and toe boards at platform level may be one (1) inch by six (6) inch wood or the equivalent. Posts shall not be over eight (8) feet apart.

5.7 Barricades where required shall be secured against accidental displacement and shall be maintained in place except where temporary removal is necessary to



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT:

CONSTRUCTION/DEMOLITION

NUMBER

32

PAGE

6 of 8

DATE FIRST
PUBLISHED

5/89

perform the work. During the period a barricade is temporarily removed for the purpose of work, a watchman shall be placed at all openings.

- 5.8 Temporary sidewalks shall be provided when a permanent sidewalk is obstructed by the trade contractor's operation. They shall be installed in accordance with the requirements listed above.
- 5.9 Warning lights shall be maintained from dusk to sunrise around excavations, barricades or obstructions in plant areas. Illumination shall be provided from dusk to sunrise for all temporary walkways in both plant and construction areas.

6. HOUSEKEEPING

A basic concept in any effective prevention endeavor is good housekeeping. No one item has a greater impact on the overall success of a safety program for a construction ~~project~~.

The importance of good housekeeping is such that it must be planned for from the beginning to the final clean-up. The degree of attention given to housekeeping will normally be reflected in the accident record, as well as in construction efficiency.

- 6.1 During the course of construction, work areas, passageways, and stairs in and around buildings and structures shall be kept clear of debris. Construction materials shall be stored in an orderly manner. Storage areas and walkways on the site shall be maintained free from dangerous depressions, obstructions, and debris.
- 6.2 The essential elements of good housekeeping are:
- o Orderly placement of materials, tools, and equipment.



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONSTRUCTION/DEMOLITION	NUMBER	32
	PAGE	7 of 8
	DATE FIRST PUBLISHED	5/89

- o Placing receptacles at appropriate locations for the disposal of miscellaneous rubbish.
- o Prompt removal and disposal of trash and waste materials.
- o Locating air and water lines, welding leads, and burning hose in positions that eliminate tripping hazards.

7. SCAFFOLDING

- 7.1 The footings and anchorage for scaffolds shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement.
- 7.2 A safe means of access to and egress from the work level must be provided. Ladders used for access/egress must be secured at top and bottom. Ladder frame scaffolds must not be offset or used with other scaffold frames.
- 7.3 No scaffold shall be erected, moved, dismantled, or altered, except under the supervision of competent persons.
- 7.4 Scaffolds and their components shall be capable of supporting without failure at least four times their maximum intended load.
- 7.5 Guardrails and toeboards shall be installed on all open sides and ends of platforms more than ten (10) feet above the ground or floor.

8. WORK AREA PROTECTION

- 8.1 Open sided floors and roofs. Any open area four (4) or more feet above adjacent surfaces shall be protected by a substantial quadrail able to resist 200 lbs. of horizontal force, a steel perimeter cable, or



OHM

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONSTRUCTION/DEMOLITION	NUMBER
	32
	PAGE
	8 of 8
	DATE FIRST PUBLISHED
	5/89

a warning system such as flagging or caution tape installed a minimum of six feet from the surface's exposed edge.

- 8.2 Floor openings. Floor openings through which personnel or material can pass should be protected by a cover or barricade, substantial enough to withstand any anticipated load. Covers shall be anchored and identified to prevent accidental removal or displacement.
- 8.3 Warning signs, barricades, and flagging are to be used to warn personnel of potential or hidden hazards or advise of intermittent activities which might endanger outside personnel. They are not to be used in lieu of more effective protection.
- 8.4 Ventilation. Adequate ventilation or localized exhaust may be required to satisfy the work environment requirement of OSHA (1926.55, 57). Such equipment as is necessary shall be furnished by the trade contractor unless other arrangements have been made in writing.
- 8.5 Illumination. If temporary illumination furnished by others is inadequate, the trade contractor is responsible to notify the construction manager of these deficiencies.
- 8.6 Protection of vertical rebar. Employees shall not be permitted to work above vertically protruding reinforcing steel unless it has been covered or protected to eliminate the hazard of persons falling on it and being impaled.

**OHM**

HEALTH AND SAFETY PROCEDURES

SUBJECT: CONTRACTOR REQUIREMENTS	NUMBER
	36
	PAGE
	1 of 1
	DATE FIRST PUBLISHED
	5/89

1. POLICY

Contractors of OHM will comply with all applicable health and safety regulations as well as OHM site safety plans.

2. PURPOSE

The purpose of the procedure is to provide OHM contracting agents a method to verify contractor compliance with health and safety requirements.

3. REQUIREMENTS

- 3.1 Contracting agents shall forward copies of the attached documents to prospective contractors or subcontractors as part of the contractor prequalification process.
- 3.2 OHM contracting agents shall assure completion of the Contractor Site Safety Rules Checklist and maintain copies with the project file.
- 3.3 Project managers shall maintain copies of forms at project sites for issuance to contractors.
- 3.4 Contractor employees shall attend a site safety plan review prior to the start of each project and sign the acknowledgement.
- 3.5 Contractors who use OHM owned personal protective equipment or other supplies will sign the indemnification and release agreement.
- 3.6 Copies of all the forms described here follow this procedure.



OHM

CONTRACTOR SITE SAFETY RULES CHECKLIST

The following check list shall be reviewed and signed by the prime contractor, and his subs, and OHM's project manager or job site supervisor of designees, prior to the scheduled start of a job. While the job is in progress, where applicable, hazardous operations permits shall be obtained on a daily basis, or more frequently, as appropriate to assure safety.

General

- ☐ All vehicles shall observe a maximum speed limit of 10 MPH, unless otherwise posted. There will be no passing of moving vehicles at job sites when narrow roads and short-sight distances exist.
- ☐ Hard hat and approved eye protection are required at all times except in designated areas.
- ☐ Smoking or eating is permitted only in designated areas.
- ☐ Contractor is expected to maintain good housekeeping during the duration of work. Daily trash pick up is required. At the end of the job the Contractor shall leave the job site in at least as good an appearance and condition as it was found.
- ☐ Contractor is to provide first-aid kit. Contractor hereby prescribes emergency hospital as indicated below:
 Hospital: _____ Phone: _____
 Address: _____
- ☐ Review with site supervisor the emergency evacuation route and telephone location. In case of emergency, notify site supervision immediately and call the appropriate service. ~~---~~
 Fire Department: _____
 Ambulance: _____
 Sheriff: _____
- ☐ OHM work rules also prohibit:
 - Possession or consumption of intoxicants or illegal drugs or narcotics
 - Violation of Federal and State safety regulation
 - Gambling
 - Possession of firearms
 - Fighting, horseplay, or practical joking
 - Sabotage or pilfering
 - Running, except in an emergency
- ☐ All accidents (personal injury or property damage) shall be reported to the site supervisor as soon as emergency conditions no longer exist. The person involved shall make a written accident report prior to leaving the site, unless prevented by emergency conditions, e.g., injury.

- ☐ There shall be no personnel on the work site except for authorized contractor / subcontractor employees without OHM management approval.
- ☐ OHM representative has discussed with the contractor and his subcontractors, the nature of the potential hazards that may be encountered.

Hazardous Atmospheres and Hazardous Environments

- ☐ Contractor shall provide his own calibrated combustible gas / oxygen analyzer or other instruments for checking areas before confined space, hot work, or other work in hazardous atmospheres or environments. Contractor is responsible for all testing and monitoring required by applicable regulations. No testing by OHM shall be in lieu of above requirements.
- ☐ Contractor shall provide a standby during confined space work and a fire watch during hot work.
- ☐ Hot work, confined space entry, line opening procedures, scaffolding, use of heavy equipment, excavations and trenching, and other planned hazardous atmospheres and hazardous environment activities shall be reviewed with site supervisor before commencing work.
- ☐ Contractor personnel shall know the location of the nearest fire extinguisher, fire water line, safety shower, and eye bath.
- ☐ Any change of conditions around hot work, confined space, or other hazardous atmosphere or hazardous environment areas which could affect previous test readings or safety conditions shall invalidate all permits and approvals. Retesting or reevaluation of the area, by a designated person, is required before work can be resumed.

Contractors are expected to brief their employees and enforce these rules. OHM management may stop or suspend work, at no cost to OHM, any time the Contractor fails to comply with Thortec International Safety Requirements.

Contractor Signature

Date

OHM Representative
Signature

Date

Name Printed

Name Printed

 OHMINDEMNIFICATION AND RELEASE AGREEMENT

FOR AND IN CONSIDERATION OF the use by the undersigned of property belonging to O.H. Materials Corp. (hereinafter referred to as "OHM") and which may include full-face mask respirators, self-contained breathing apparatus, and other equipment and supplies, and other good and valuable consideration, the undersigned, for himself and his successors, and assigns, does hereby release and discharge OHM, their officers, employees, agents, and subcontractors from any and all claims, actions, demands, damages, costs, loss of services, expenses, compensation, third-party actions, or suits, including attorneys fees, arising and resulting from the aforementioned use of property, equipment, or supplies belonging to OHM.

In particular, the undersigned, for himself and his successors, and assigns, agrees to save, hold harmless, protect, indemnify, and defend OHM, and its officers, employees, agents, and subcontractors against any and all claims, actions and expenses as above described, whether for bodily injury, property damage or destruction, or both, arising or resulting in any way from the use by the undersigned of property of OHM and agrees to save, hold harmless, protect, indemnify, and defend OHM against any such claims, actions, or expenses, referenced above, that might be brought against OHM by any third persons or the heirs, successors, executors or assigns of the undersigned.

The undersigned acknowledges by the signing hereof that he has carefully read this Agreement, understands the contents thereof, and has freely and voluntarily signed the same.

WITNESS my hand this _____ day of _____, 19__.

SIGNED AND ACKNOWLEDGED
IN THE PRESENCE OF:

APPENDIX D

WORKER ACKNOWLEDGEMENT TO HEALTH
AND SAFETY PLAN

WORKER ACKNOWLEDGEMENT TO HEALTH-AND-SAFETY PLAN

I HAVE READ THE SITE-SAFETY PLAN FOR THIS SITE AND FULLY UNDERSTAND ITS CONTENTS.

NAME

DATE _____

[illegible]

Appendix E

RESPONSES TO COMMENTS SUBMITTED BY EPA AND SHELL OIL COMPANY

10 1 AUG 1989 *nd*



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION VIII

999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

JUL 31 1989

Ref: 8HWM-SR

Mr. Donald L. Campbell
Office of the Program Manager
Rocky Mountain Arsenal
ATTN: AMXRM-PM
Commerce City, Colorado 80022-2180

Re: Rocky Mountain Arsenal (RMA)
Draft Final Task Plan, Hydrazine
Blending and Storage Facility
(HBSF), Interim Response Action
Implementation, June 1989.

Dear Mr. Campbell:

We have reviewed the above referenced document and the accompanying Sampling Design Plan, Quality Assurance Program Plan, and the Safety Plan for this IRA. We have the enclosed comments. The more important issues were discussed at the HBSF Subcommittee on July 21, 1989, and were resolved in these discussions with Army representatives. Please contact Linda Grimes at (303) 293-1262, if you have questions on this matter.

Sincerely,

Linda Grimes
for Connally Mears
EPA Coordinator for RMA Cleanup

Enclosure

cc: Jeff Edson, CDH
David Shelton, CDH
Vicky Peters, CAGO
Lt. Col. Scott P. Isaacson
Chris Hahn, Shell
R. D. Lundahl, Shell
John Moscato, DOJ
David Anderson, DOJ

2014 8-12

COMMENTS ON THE DRAFT FINAL TASK PLAN, THE SAMPLING DESIGN PLAN,
THE QUALITY ASSURANCE PROGRAM PLAN, AND THE SAFETY PLAN FOR THE
HYDRAZINE BLENDING AND STORAGE FACILITY
INTERIM RESPONSE ACTION IMPLEMENTATION
JUNE 1989

1. Passages from the Decision Document, on pages 33, 34 and 52, reflect EPA's understanding of the Army's agreed approach to treatment of the hydrazine blending and storage facility wastewater. The Army agreed to attempt lowering of the detection limit for NDMA and extrapolation of the treatment curve to attain the Ambient Water Quality Criteria for NDMA of 1.4 ppt, prior to release from the treatment system. Following discussions with Army staff, it is our understanding that page 7, Section 1.2.4, and page 9, Section 2.2.2, of the Draft Final Task Plan, will be modified to reflect the approach agreed upon in the Decision Document.
2. As discussed at the HBSF Subcommittee and as agreed by the Army, we wish to emphasize that we fully anticipate compliance with ARARs established for this IRA, during the onpost pilot treatment studies. Further, all onpost treatability studies, with potential for releases, are subject to ARARs analysis and compliance.
3. Although soils and groundwater remediation are not within the scope of the IRA, we recommend the development of a certified reporting limit for the NDMA in soils, to be conducted during the IRA work. These issues were discussed at the HBSF Subcommittee, and the Army representatives suggested inclusion of this soil sampling as part of the data gap soils study. We request that soils sampling in the HBSF area following decommissioning be considered a data gap and be addressed by that soil sampling program.
4. It is our understanding that the assumption that destruction of NDMA would appropriately destroy other contaminants (including chlorinated hydrocarbons) would be further assessed during the initial system tests to properly select compounds to be monitored. Based on discussions with Army representatives, the currently planned pilot testing and startup testing will include this evaluation.
5. We have concerns that potential air release of NDMA was evaluated for workers only and not offpost areas. At our request, Army representatives have agreed to conduct an evaluation of the potential for the exposure of offpost areas and the placement of statements in the Task Plan to reflect this.
6. The plan does not monitor for BOD₅ and chemical oxygen demand of the effluent from the treatment system. The BOD₅ and chemical oxygen demand should be compared with the influent

levels to predict the potential loading of BOD on the sewage treatment plant. A discharge of 1,000 gallons of treated wastewater with a high BOD concentration could have an adverse effect on the sewage treatment plant, possibly causing a violation of the effluent limitations in the NPDES permit.

7. Draft Final Task Plan, page 5, clarify the text that further treatment of the 10,000 gallons of startup wastewater may be necessary to achieve acceptable discharge levels. What is the anticipated storage time in tanks?

8. Draft Final Task Plan, page 7, last paragraph, is there a prediction of the anticipated quantity of rinse water produced and subsequently treated by this system and released to the sewer system? The decommissioning phase should review other methods to decontaminate the storage units, since the levels of NDMA in the air within the tanks used to blend, formulate, and store hydrazine ranges from 0.20 ug/m³ to 28 ug/m³ (page 8, Draft Final Safety Plan).

9. Draft Final Task Plan, pages 5 and 11, we note that weather impacts have been considered in the selection and design of the electrical system. Have temperature effects on the UV/oxidation process performance been evaluated?

10. Draft Final Task Plan, pages 9 and 10, and Draft Final Sampling Design Plan, pages 5 and 6, the text states that pretreatment may be necessary to remove sediments, metals, and other contaminants. The concentrations of other contaminants should be better evaluated and Table 2.1 expanded to indicate their levels. This assessment should include the analyses results for pH, hardness (scale control on UV quartz tubes), total organic carbon, chloride, ammonia, nitrate, etc. Also, further testing should be done to better define the concentration levels; for example, Table 2.1 lists UDMH at concentrations ranging from greater than 5 to 1000 ppm. If the impact of concentration variation on system optimization has been evaluated, the results should be presented.

11. Draft Final Task Plan, page 11, since the catalyst has not been identified at this point, its effluent discharge may not be regulated as part of the NPDES discharge to the RMA sanitary sewer. After a catalyst has been selected, notify EPA so that we can assure proper monitoring is occurring.

12. Draft Final Task Plan, pages 12 and 13, the text states that the supervision of the treatment process will be limited to 16 hours; will the reaction proceed unmonitored by an operator beyond this point? Will there be checks/alarms to alert temperature buildup or leakage; is there a remote alarm notification system? It is stated that an automatic shutdown

will occur in the event of a system failure; are any operator procedures required following automatic shutdown?

13. Draft Final Safety Plan, page 7, is ground water monitoring being conducted for the inground concrete tank? Is this tank covered?

14. Draft Final Safety Plan, page 7, from what drum filling and washing operations were residues collected and stored in the inground concrete tank?

15. Draft Final Safety Plan, page 7A, the figure should include the location of the inground tank and the equipment sheds.

16. Draft Final Safety Plan, page 23, Section 6.6, what are the predetermined concentrations against which ambient air levels will be monitored?

17. Draft Final Safety Plan, refer to earlier Comment 5, regarding public protection, the system will be equipped with an audible alarm activated when the Threshold Limit Value (TLV) of 0.1 ppm is exceeded. When the plant is unattended, the audible/visual alarm will be activated, how will RMA personnel be aware of the alarm; is there a remote alarm notification system? Also, this section establishes a notification procedure, which is not inclusive of public notification. Procedures and levels must be determined that are protective of the public and a contingency plan developed for releases that could impact public health.

18. Draft Final Sampling Design Plan, pages 8 and 10, in regard to the evaluation of the off-gassing from a non-ozone system, there are contradictions. In one case, it is stated that the off-gas stream will not be sampled; in the second instance, it is stated that the off-gassing from the hydrogen peroxide process will be evaluated. Please amend the text to clarify this apparent contradiction.

19. Draft Final Sampling Design Plan, page 13, are CRLs currently in existence for other contaminants of concern in the wastewater?

20. Draft Final Quality Assurance Program Plan, page 4, please list what materials, other than anhydrous hydrazine and unsymmetrical dimethylhydrazine, were loaded and unloaded here. Also, expand the text to include any history of spills of these substances here.

21. Draft Final Quality Assurance Program Plan, pages 5 and 7, it is our understanding that the Draft Implementation Document will address the treatment of the approximately 300,000 gallons of hydrazine wastewater. Further, we understand that the selection of the "full-scale treatment system" and its startup

testing will occur following review and comment by the parties of the Implementation Document (refer to Sections 22.13 and 22.14 of the FFA). Please amend the text to reflect that this agreed procedure will be followed.

22. Draft Final Task Plan, the following technical information, regarding the bench scale/pilot testing program, is requested:

- a. What type of reactor system is going to be used for the bench scale test and what are the scale-up problems associated with that system?
- b. Are different intensity UV lamps to be evaluated in this phase?
- c. Are different UV wavelengths to be evaluated in this phase?
- d. What data will be generated to do the treatment extrapolation for NDMA required by the Final Decision Document?
- e. Are different treatment pHs to be evaluated?
- f. Will the effluent from the bench/pilot testing be evaluated for the formation of degradation by-products which have been observed in other testing?
- g. Will pH measurements be taken on the influent and effluent samples from the bench/pilot testing?
- h. Will the sampling procedure minimize vapor space in the sample containers to ensure that VOCs are not purged from the sample during transport?

testing will occur following review and comment by the parties of the Implementation Document (refer to Sections 22.13 and 22.14 of the FFA). Please amend the text to reflect that this agreed procedure will be followed.

22. Draft Final Task Plan, the following technical information, regarding the bench scale/pilot testing program, is requested:

- a. What type of reactor system is going to be used for the bench scale test and what are the scale-up problems associated with that system?
- b. Are different intensity UV lamps to be evaluated in this phase?
- c. Are different UV wavelengths to be evaluated in this phase?
- d. What data will be generated to do the treatment extrapolation for NDMA required by the Final Decision Document?
- e. Are different treatment pHs to be evaluated?
- f. Will the effluent from the bench/pilot testing be evaluated for the formation of degradation by-products which have been observed in other testing?
- g. Will pH measurements be taken on the influent and effluent samples from the bench/pilot testing?
- h. Will the sampling procedure minimize vapor space in the sample containers to ensure that VOCs are not purged from the sample during transport?

FCD:July 31 , 1989:asap\hbsfrv.new

bcc: Connally Mears, 8HWM-SR
Linda Grimes, 8HWM-SR
Kay Modi, 8HWM-SR
Bill Clemmens, 8RC
Mike Gaydosh, 8RC
Bruce Ray, 8RC
Mike Smith, CDM

RESPONSES TO COMMENTS SUBMITTED BY THE
U.S. ENVIRONMENTAL PROTECTION AGENCY, REGION VIII, ON THE
DRAFT FINAL TASK PLAN, SAMPLING DESIGN PLAN,
QUALITY ASSURANCE PROGRAM PLAN, AND SAFETY PLAN FOR THE
HYDRAZINE BLENDING AND STORAGE FACILITY
INTERIM RESPONSE ACTION

Comment No. 1

Passages from the Decision Document, on pages 33, 34, and 52, reflect EPA's understanding of the Army's agreed approach to treatment of the hydrazine blending and storage facility wastewater. The Army agreed to attempt lowering of the detection limit for NDMA and extrapolation of the treatment curve to attain the Ambient Water Quality Criteria for NDMA of 1.4 ppt. prior to release from the treatment system. Following discussions with Army staff, it is our understanding that page 7, Section 1.2.4, and page 9, Section 2.2.2, of the Draft Final Task Plan, will be modified to reflect the approach agreed upon in the Decision Document.

Response

EPA's understanding is correct, and the text of the Task Plan has been modified to reflect the approach agreed upon in the Decision Document.

Comment No. 2

As discussed at the HBSF Subcommittee and as agreed by the Army, we wish to emphasize that we fully anticipate compliance with ARARs established for this IRA during the onpost pilot treatment studies. Further, all onpost treatability studies, with potential for releases, are subject to ARARs analysis and compliance.

Response

Comment noted.

Comment No. 3

Although soils and groundwater remediation are not within the scope of the IRA, we recommend the development of a certified reporting limit for NDMA in soils to be conducted during the IRA work. These issues were discussed at the HBSF Subcommittee, and the Army representatives suggested inclusion of this soil sampling as part of the data gap soils study. We request that soils sampling in the HBSF area following decommissioning be considered a data gap and be addressed by that soil sampling program.

Response

EPA's understanding that soils and ground-water remediation are not within the scope of the IRA is correct; therefore, a CRL for NDMA in soils will not be developed during the IRA work. Soil sampling for NDMA in the HBSF area was conducted in 1988 and 1989. The data and results were presented in the "Final Phase I Contamination Assessment Report, Site 1-7, Hydrazine Blending and Storage Facility, Version 3.2" (September 1988) and in the "Final Phase II Data Addendum, Site 1-7, Hydrazine Blending and Storage Facility, Version 3.1" (February 1989). It should be noted that no NDMA was detected at or above detection limits in either study and that

the detection limit was lowered by a factor of 10 between Phase I and Phase II. The Army believes that sufficient data already exist on NDMA in soils in the HBSF area and therefore does not consider HBSF soils sampling for NDMA to be a data gap.

Comment No. 4

It is our understanding that the assumption that destruction of NDMA would appropriately destroy other contaminants (including chlorinated hydrocarbons) would be further assessed during the initial system tests to properly select compounds to be monitored. Based on discussions with Army representatives, the currently planned pilot testing and startup testing will include this evaluation.

Response

EPA's understanding is correct.

Comment No. 5

We have concerns that potential air release of NDMA was evaluated for workers only and not offpost areas. At our request, Army representatives have agreed to conduct an evaluation of the potential for the exposure of offpost areas and the placement of statements in the Task Plan to reflect this.

Response

EPA's understanding is correct, and the following text will be added as a seventh bullet in Section 1.1.3.2 of the Task Plan: "The EPA Industrial Source Complex Dispersion Model (EPA, 1987) will be used to determine whether exposure to Off-Post areas will occur if airborne NDMA is released from the hydrazine wastewater treatment system."

Comment No. 6

The plan does not monitor for BOD₅ and chemical oxygen demand of the effluent from the treatment system. The BOD₅ and chemical oxygen demand should be compared with the influent levels to predict the potential loading of BOD on the sewage treatment plant. A discharge of 1,000 gallons of treated wastewater with a high BOD concentration could have an adverse effect on the sewage treatment plant, possibly causing a violation of the effluent limitations in the NPDES permit.

Response

Based on the existing analytical results for hydrazine wastewater at the HBSF and anticipated concentrations of NDMA, hydrazine fuels, and other organics in treated effluent from the hydrazine wastewater treatment system, the BOD₅ and COD concentrations in the treated effluent are expected to be insignificant.

To verify BOD₅ and COD concentrations in the treated effluent from the hydrazine wastewater treatment system, BOD₅ and COD analyses will be included in the start-up testing program.

Comment No. 7

Draft Final Task Plan, page 5, clarify the text that further treatment of the 10,000 gallons of startup wastewater may be necessary to achieve acceptable discharge levels. What is the anticipated storage time in tanks?

Response

Treated effluent from the chemical oxidation/UV treatment system will be stored in effluent storage tanks prior to discharge. Samples of the effluent will be shipped for analyses to the analytical laboratory certified for analysis of NDMA and hydrazine fuels. Based on the results of the analyses relative to CRLs for these compounds, the treated effluent will be either discharged to the RMA sanitary sewer or directed to the hydrazine wastewater treatment system for further treatment.

The anticipated storage time for the treated effluent is approximately 30 days, the length of time required to receive preliminary corrected results from the analytical laboratory.

Comment No. 8

Draft Final Task Plan, page 7, last paragraph, is there a prediction of the anticipated quantity of rinse water produced and subsequently treated by this system and released to the sewer system? The decommissioning phase should review other methods to decontaminate the storage units, since the levels of NDMA in the air within the tanks used to blend, formulate, and store hydrazine ranges from 0.20 $\mu\text{g}/\text{m}^3$ to 28 $\mu\text{g}/\text{m}^3$ (page 8, Draft Final Safety Plan).

Response

An estimate of the anticipated quantity of rinse water generated during decommissioning, subsequently treated by the hydrazine wastewater treatment system, and discharged to the RMA sanitary sewer is not available at this time. An estimate will be prepared and will be included in the Draft Implementation Document for decommissioning of the HBSF.

All decontamination methods were assessed in the assessment phase of the IRA and were presented in the Final Assessment Document. The Final Decision Document for the IRA specifies the decommissioning process.

Comment No. 9

Draft Final Task Plan, pages 5 and 11, we note that weather impacts have been considered in the selection and design of the electrical system. Have temperature effects on the UV/oxidation process performance been evaluated?

Response

Temperature effects on the performance of the UV/oxidation process treating hydrazine wastewater from the HBSF have not been evaluated to date. These effects will be evaluated during the start-up testing phase of this task. The temperature of the hydrazine wastewater will increase during the UV/oxidation process. A chiller will be included with the hydrazine wastewater treatment system to control temperature increase.

Comment No. 10

Draft Final Task Plan, pages 9 and 10, and Draft Final Sampling Design Plan, pages 5 and 6, the text states that pretreatment may be necessary to remove sediments, metals, and other contaminants. The concentrations of other contaminants should be better evaluated and Table 2.1 expanded to indicate their levels. This assessment should include the analyses results for pH, hardness (scale control on UV quartz tubes), total organic carbon, chloride, ammonia, nitrate, etc. Also, further testing should be done to better define the concentration levels; for example, Table 2.1 lists UDMH at concentrations ranging from greater than 5 to 1000 ppm. If the impact of concentration variation on system optimization has been evaluated, the results should be presented.

Response

The impact of concentration variation on optimization of the hydrazine wastewater treatment system has not been evaluated to date. Additional sampling and analysis of the contents of the three tanks that contain hydrazine wastewater at the HBSF will be conducted to better assess concentrations of the parameters listed in Table 2.1 of the Draft Final Task Plan. Analyses for parameters that may affect performance of the hydrazine wastewater treatment system (e.g., pH, hardness) will be performed. The sampling locations, parameters, and methods of analysis for this additional sampling and analysis will be presented as an addendum to the Sampling Design Plan prior to the work being performed.

Comment No. 11

Draft Final Task Plan, page 11, since the catalyst has not been identified at this point, its effluent discharge may not be regulated as part of the NPDES discharge to the RMA sanitary sewer. After a catalyst has been selected, notify EPA so that we can assure proper monitoring is occurring.

Response

Comment noted. The Army will coordinate with EPA to ensure that necessary revisions are made to the NPDES permit application where appropriate. EPA will be notified when a catalyst has been selected.

Comment 12

Draft Final Task Plan, pages 12 and 13, the text states that the supervision of the treatment process will be limited to 16 hours; will the reaction proceed unmonitored by an operator beyond this point? Will there be checks/alarms to alert temperature buildup or leakage; is there a remote alarm notification system? It is stated that an automatic shutdown will occur in the event of a system failure; are any operator procedures required following automatic shutdown?

Response

No remote alarm notification system is planned, as an operator will be present at all times during system operation. Instrumentation will be included with the system to monitor process parameters such as temperature, pH, pressure, and flow rate. Real-time monitoring will be included for airborne hydrazine fuels. Non-real-time monitoring will be performed for airborne NDMA. Tanks within the system will include high-level alarms.

Operator procedures following automatic shutdown will be required. These procedures will be outlined in the Draft Operation and Program Manual for the hydrazine wastewater treatment system. This manual will be prepared prior to start-up operation of the system.

Comment No. 13

Draft Final Safety Plan, page 7, is ground water monitoring being conducted for the inground concrete tank? Is this tank covered?

Response

Ground-water monitoring for the in-ground concrete tank/sump will not be conducted as a part of Phase I of this IRA. The tank is not covered.

Comment No. 14

Draft Final Safety Plan, page 7, from what drum filling and washing operations were residues collected and stored in the inground concrete tank?

Response

The statement on page 7 of the Draft Final Safety Plan regarding drum filling and washing operations refers to page 1-13 of the Final Assessment Document, which states that dirty drums and drums to be reused were cleaned before filling, and residues were poured into the in-ground tank/sump. This statement reflects all information in the available documents.

Comment No. 15

Draft Final Safety Plan, page 7A, the figure should include the location of the inground tank and the equipment sheds.

Response

Figure 3.1 of the Final Safety Plan has been modified to show the locations of the in-ground tank and equipment sheds.

Comment No. 16

Draft Final Safety Plan, page 23, Section 6.6, what are the predetermined concentrations against which ambient air levels will be monitored?

Response

The U.S. Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PELs) and American Conference of Government Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) for hydrazine, MMH, and UDMH are as follows:

	<u>PEL and TLV</u>
Hydrazine	0.1 ppm
MMH	0.2 ppm
UDMH	0.5 ppm

Comment No. 17

Draft Final Safety Plan, refer to earlier Comment 5, regarding public protection, the system will be equipped with an audible alarm activated when the Threshold Limit Value (TLV) of 0.1 ppm is exceeded. When the plant is unattended, the audible/visual alarm will be activated, how will RMA personnel be aware of the alarm; is there a remote alarm notification system? Also, this section establishes a notification procedure, which is not inclusive of public notification. Procedures and levels must be determined that are protective of the public and a contingency plan developed for releases that could impact public health.

Response

No remote alarm notification system is planned, as an operator will be present at all times during system operation. PMRMA has an established notification procedure that will be followed.

Comment No. 18

Draft Final Sampling Design Plan, pages 8 and 10, in regard to the evaluation of the off-gassing from a nonozone system, there are contradictions. In one case, it is stated that the off-gas stream, will not be sampled; in the second instance, it is stated that the off-gassing from the hydrogen peroxide process will be evaluated. Please amend the text to clarify this apparent contradiction.

Response

Section 3.1.5 of the Sampling Design Plan refers to off-gas testing during bench/pilot-scale testing; no off-gas testing is planned for the non-ozone unit during bench/pilot-scale testing. Section 3.2.4 refers to off-gas testing during start-up testing; the selected treatment unit will be tested for off-gassing during start-up testing. Whether an ozone or a non-ozone chemical oxidation/UV system is selected, provisions will be incorporated in the design of the hydrazine wastewater treatment system to collect gases that may be generated in the unit processes and tanks employed in the treatment system. The design will include a series of seal water tanks, through which off-gases must pass. At the end of a batch run during start-up operation, the seal water will be analyzed to determine whether off-gassing occurred during the run.

Comment No. 19

Draft Final Sampling Design Plan, page 13, are CRLs currently in existence for other contaminants of concern in the wastewater?

Response

Yes. CRLs exist for all contaminants listed on page 10 of the Draft Final Task Plan except (1) sodium hypochlorite and chlorine residuals, which do not have certifiable methods and (2)

dimethylcyanamide, N-N-dimethylformamide, 1-ethyl 1H 1,2,4-Triazole, and Silvex, which at this point are considered tentatively identified compounds (TICs).

Comment No. 20

Draft Final Quality Assurance Program Plan, page 4, please list what materials, other than anhydrous hydrazine and unsymmetrical dimethylhydrazine, were loaded and unloaded here. Also, expand the text to include any history of spills of these substances here.

Response

The Final Assessment Document contains the information pertaining to history of loading and unloading as well as spills.

Comment No. 21

Draft Final Quality Assurance Program Plan, pages 5 and 7, it is our understanding that the Draft Implementation Document will address the treatment of the approximately 300,000 gallons of hydrazine wastewater. Further, we understand that the selection of the "full-scale treatment system" and its startup testing will occur following review and comment by the parties of the Implementation Document (refer to Sections 22.13 and 22.14 of the FFA). Please amend the text to reflect that this agreed procedure will be followed.

Response

EPA's understanding that the Draft Implementation Document will address treatment of approximately 300,000 gallons of hydrazine wastewater is correct. Selection of the full-scale treatment system and its start-up testing, however, will occur during the design phase of the project and prior to issuing the Draft Implementation Document. As discussed at the RMA Subcommittee meeting on July 21, 1989, the full-scale treatment system has been selected, and, based on the results of the start-up testing, any necessary modifications will be implemented and recommendations for full-scale treatment will be made. Modifications and recommendations will be presented in the Draft Final Implementation Document for review and comment by the parties, per Sections 22.13 and 22.14 of the Federal Facility Agreement.

Comment No. 22

Draft Final Task Plan, the following technical information for the bench scale/pilot testing program, is requested:

- A. *What type of reactor system is going to be used for the bench scale test and what are the scale-up problems associated with that system:*

Response

Three chemical oxidation/UV reactor system configurations will be evaluated during the bench/pilot-scale testing program:

- Hydrogen peroxide/ozone (or ozone alone) in combination with multiple low-intensity UV rays (254 nm wavelength): bench-scale

- Hydrogen peroxide in combination with multiple high-intensity UV lamps (254 nm wavelength): bench-scale
- Hydrogen peroxide/ozone (or ozone alone) in combination with a single medium-intensity UV lamp (broad wavelength: 200 to 350 nm): pilot-scale

Scale-up problems, if any, are unknown at this time and cannot be predicted.

B. Are different intensity UV lamps to be evaluated in this phase?

Response

Yes, see response to Comment 22A.

C. Are different UV wavelengths to be evaluated in this phase?

Response

Yes, see response to Comment 22A.

D. What data will be generated to do the treatment extrapolation for NDMA required by the Final Decision Document?

Response

Because of the volume of sample required to characterize the treated effluent generated from a particular bench-scale or pilot-scale run, no sampling during the intermediate stages of a run is anticipated. Thus, generation of concentration versus time curves or kinetic modeling for treatment of NDMA is not an objective of the bench/pilot-scale testing program. Generation of data for extrapolation of treatment for NDMA is planned for the full-scale start-up testing phase of the task.

E. Are different treatment pHs to be evaluated?

Response

Yes. Each vendor will provide recommendations regarding optimum pH for treatment of hydrazine wastewater from the HBSF.

F. Will the effluent from the bench/pilot testing be evaluated for the formation of degradation by-products which have been observed in other testing?

Response

Yes. Refer to pages 5, 7A, 8, and 14 of the Draft Final Sampling Design Plan for the parameters to be analyzed in the final treated effluent samples.

G. Will pH measurements be taken on the influent and effluent samples from the bench/pilot testing?

Response

Yes.

H. Will the sampling procedure minimize vapor space in the sample containers to ensure that VOCs are not purged from the sample during transport?

Response

Yes.

Shell Oil Company



One Shell Plaza
P O. Box 4320
Houston, Texas 77210

July 17, 1989

Office of the Program Manager for Rocky Mountain Arsenal
ATTN: AMXRM-PM: Mr. Donald L. Campbell
Rocky Mountain Arsenal, Building 111
Commerce City, Colorado 80022-2180

Dear Mr. Campbell:

Shell Oil has the following comments on the Draft Final Task Plan for Hydrazine Blending and Storage Facility Interim Response Action Implementation, June 30, 1989:

The text at Section 6.2 of the Quality Assurance Program Plan could be misleading by suggesting that all of the compounds listed in Table 6.2 are target analytes for this IRA. In fact, the compounds listed in Table 6.2 are all compounds susceptible to analysis by the respective method listed.

In Section 2.2 of the Draft Task Plan, why is the operating schedule, i.e., 5-day week, 16 hours per day, treated as a performance specification? Usually, best economies of capital and operating expense are realized by treating the operating schedule as a variable.

Sincerely,

R. D. Lundahl
Manager Technical
Denver Site Project

RDL:ajg

cc: Office of the Program Manager for Rocky Mountain Arsenal
ATTN: AMXRM-PM: Col. Daniel R. Voss
Bldg. E-4460
Aberdeen Proving Ground, MD 21010-5401

Office of the Program Manager for Rocky Mountain Arsenal
ATTN: AMXRM-PM: Ms. Kathryn R. Cain
Rocky Mountain Arsenal, Building 111
Commerce City, Colorado 80022-2180

E-16

cc: Office of the Program Manager for Rocky Mountain Arsenal
ATTN: AMXRM-RP: Mr. Kevin T. Blose
Rocky Mountain Arsenal, Building 111
Commerce City, Colorado 80022-2180

Office of the Program Manager for Rocky Mountain Arsenal
ATTN: AMXRM-TO: Mr. Brian L. Anderson
Rocky Mountain Arsenal, Building 111
Commerce City, Colorado 80022-2180

Mr. David L. Anderson
Department of Justice
c/o Acumenics Research & Technology
999 18th Street
Suite 501, North Tower
Denver, Colorado 80202

Department of the Army
Environmental Litigation Branch
Pentagon, Room 2D444
ATTN: DAJA-LTE: Lt. Col. Scott Isaacson
Washington, DC 20310-2210

Victoria L. Peters, Esq.
Assistant Attorney General
CERCLA Litigation Section
1560 Broadway, Suite 250
Denver, CO 80202

Mr. Jeff Edson
Hazardous Materials and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, CO 80220

Mr. Robert L. Duprey
Director, Hazardous Waste Management Division
U.S. Environmental Protection Agency, Region VIII
One Denver Place
999 18th Street, Suite 500
Denver, CO 80202-2405

Mr. Connally Mears, 8HWM-SR
EPA Coordinator for Rocky Mountain Arsenal
US EPA, Region VIII, Superfund
999 18th Street, Denver Place, Suite 500
Denver, CO 80202-2405

cc: Mr. Thomas P. Looby
Assistant Director
Colorado Department of Health
4210 East 11th Avenue
Denver, CO 80220

RESPONSES TO COMMENTS SUBMITTED BY SHELL OIL COMPANY ON THE
DRAFT FINAL TASK PLAN, SAMPLING DESIGN PLAN,
QUALITY ASSURANCE PROGRAM PLAN, AND SAFETY PLAN FOR THE
HYDRAZINE BLENDING AND STORAGE FACILITY INTERIM RESPONSE ACTION

Comment No. 1

The text at Section 6.2 of the Quality Assurance Program Plan could be misleading by suggesting that all of the compounds listed in Table 6.2 are target analytes for this IRA. In fact, the compounds listed in Table 6.2 are all compounds susceptible to analysis by the respective method listed.

Response

The third sentence in the first paragraph of Section 6.2 has been changed to read: "Table 6.2 presents a summary of analytical methods used for analysis of wastewater samples along with the compounds susceptible to analysis by each method."

Comment No. 2

In Section 2.2 of the Draft Task Plan, why is the operating schedule, i.e., 5-day week, 16 hours per day, treated as a performance specification? Usually, best economies of capital and operating expenses are realized by treating the operating schedule as a variable.

Response

Comment noted. Based on previous chemical oxidation/UV treatability work by IITRI with hydrazine wastewater, the length of a batch-mode run was estimated to be approximately 14 hours. Thus, a 16-hour time period for one batch-mode run is estimated for start-up testing of the full-scale hydrazine wastewater treatment system at the HBSF. Results of the start-up testing will establish the optimal batch-mode treatment time for the full-scale treatment system.

No comments were received from the State of Colorado on the Draft Final Task Plan, Sampling Design Plan, Quality Assurance Program Plan, and Safety Plan for the Hydrazine Blending and Storage Facility Interim Response Action.